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Forest Habitat Types in the Apache, Gila, and Part of the Cibola National Forests, Arizona and New Mexico

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Abstract

A habitat type classification is described for forests in the mountains of the Apache, Gila, and Cibola (Magdalena District only) National Forests in Arizona and New Mexico. Using methods modified from those originally developed by Rexford Daubenmire, 7 series, including 40 habitat types and one community type were identified. Descriptions of the habitat types, management implications, association tables, and a key to the types are presented.

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INTRODUCTION

Rexford Daubenmire introduced and developed the habitat type system of ecological classification in the western United States (Daubenmire 1952, Daubenmire and Daubenmire 1968) to provide homogeneous ecological categories for information storage and retrieval, and for predictive capability (Layser 1974, Daubenmire 1976, Pfister 1981). Daubenmire's method defined areas of the land surface which supported similar and recurring patterns of vegetation in an undisturbed state and were considered to have equivalent ecological responses and potential. Several ecologists have further developed and applied the system, modifying the field techniques for greater efficiency and in some cases modifying the classification methods to better fit the needs of practicing foresters. Notable among early publications is Franklin et al. (1970). Probably the most extensive application of the system to date is the work of Robert D. Pfister, who supervised classification of all the timbered National Forest land in Montana (Pfister et al. 1977). Similar work has been done or is still in progress in all 11 western states except, to the best of our knowledge, in Nevada.

In 1973, William H. Moir began classifying the spruce-fir and mixed conifer vegetation of Arizona and New Mexico (Moir and Ludwig 1979). This was a broad reconnaissance to identify the major habitat types of high elevation forests—true firs and spruces (*Abies* and *Picea*)—in the two states. In 1974, work began on a classification of the *Pinus ponderosa* forests of northern Arizona (Hanks et al. 1983). Their classification included only four National Forests, and was partially intended as a test to determine whether the Daubenmire system was practical where disturbance and slow recovery were typical. Remnant stands were found for classification purposes in most areas. Some communities had to be identified as "community types," indicating that the potential of those types was unknown.

In order to provide continuity between these early studies and future ones, a study plan was prepared for classifying coniferous vegetation of all the National Forests in New Mexico, southern Colorado, and Arizona[4]. Ecologically and climatologically similar administrative areas were grouped for the purpose of collecting and analyzing data. This report presents a classification initiated under that study plan.

The present authors and others associated with them have completed similar studies in the remaining mountain ranges of Arizona, southern Colorado, and New Mexico. Therefore, identification of habitat types and names has been carefully integrated. Results of these studies also are correlated[5] with the Terrestrial Ecosystem Survey (USDA Forest Service 1983) used in the Southwest Region of the United States Forest Service.

Habitat types identified in this and similar research correspond to the association level defined by the digitized ecosystem classification (Brown et al. 1980) and the "first approximation" of Hall (1984). Revisions of this classification are anticipated as an ongoing process as the system becomes more widely used. This classification is compatible with the national land classification system (Driscoll et al. 1983). Habitat types as used here are at the same level of classification as the "associations" defined by Forest Service Manual 2060, "Ecosystem Classification, Interpretation, and Application." The difference is that "habitat type" refers to all stands having the same potential, regardless of present seral condition, while "association" refers to an actual stand near the climax condition.

STUDY AREA

This classification includes the forested areas of the Apache National Forest (Arizona and New Mexico), the Gila National Forest (New Mexico), and the Magdalena District of the Cibola National Forest (New Mexico) (fig. 1). The Magdalena District is more similar to the Gila National Forest in plant geography, ecology, and climate than to the remainder of the Cibola National Forest. The Magdalena District is in the upper Gila Mountains Forest Province in Bailey's (1980) classification. Other timbered parts of the Cibola National Forest are in the Rocky Mountain Forest Province and are separated from the Magdalena District by a broad stretch of grassy plains and grassy or juniper-covered mountains (Bailey's Colorado Plateau Province).

The study area encompasses the southeastern end of the Mogollon Rim, a large uplifted escarpment that ex-

[4]*Ronco, Frank, Jr., William H. Moir, and E. Lee Fitzhugh. 1978. Study Plan FS#1203.78: Forest habitat type classification for Arizona, New Mexico, and southwestern Colorado. On file at the Forestry Sciences Laboratory, Rocky Mountain Forest and Range Experiment Station, Flagstaff, Ariz.*

[5]*Report of Working Group No. 4, Habitat Types and the Terrestrial Ecosystem Survey. p. 106-107.* In *Proceedings of the Workshop on Southwestern Habitat Types. April 6-8, 1983, Albuquerque, NM. Technical coordinators, W. H. Moir and Leonard Hendzel. 1983 USDA, Forest Service, Southwestern Region.*

tends north and west to northwestern Arizona. Other mountain ranges include the White and Big Lue Mountains and the Blue Range in Arizona; and in New Mexico, the San Francisco, Saliz, Tularosa, Gallo, Mangas, Mimbres, Magdalena, and San Mateo Mountains and the Black Range. Several of the mountain ranges include peaks rising above 10,000 feet (3,048 m). The Big Burro Mountains and the Pinos Altos Range in New Mexico were excluded from the study. Geological origins of the high mountains in the study area are volcanic with various kinds of igneous rocks in different parts of the area.

Moist air from the Gulf of Mexico and violent convective summer storms dominate the climate of the area. The study area forms the southeastern end of the Upper Gila Mountains Forest Province (Bailey 1980). It borders the Mexican Highlands Shrub Steppe Province, the Grama-Tobosa Section of the Chihuahuan Desert Province, and the Grama-Galleta Steppe + Juniper-Pinyon Woodland Mosaic Section of the Colorado Plateau Province. Therefore, the study area is at the confluence of four provinces and two divisions (Desert and Steppe) in Bailey's classification which, at these levels, is primarily climatological. Plants typical of all of these provinces are found in the study area, particularly at lower elevations. The study area seems to be in a region of rapid change in plant ecological relationships, and some plants appeared to have different ecological niches than reported by Hanks et al. (1983), DeVelice et al. (1986), and others. The study area is located at the apex of a "V" formed by the convergence of the eastern terminus of the Mogollon Rim of Arizona with the Continental Divide of the Rocky Mountains. The most rapid ecological change appears to occur from eastern Arizona through southern New Mexico.

Figure 1.—Location of the National Forests included in the habitat type classification study (only the Magdalena District of the Cibola was classified).

CLASSIFICATION THEORY AND NOMENCLATURE

The situation described above represents a geographical gradient, but communities are recognizable, occur with enough frequency to allow recognition, and can be classified into habitat types and phases. Thus, the relationships between gradient theory and community theory are observable in the broad geographical gradients of vegetation throughout the study area, as influenced by extensive and gradual changes in site factors. The gradients are separable into discrete associations influenced by abrupt changes in site factors. Classification is an abstraction for the convenience of users. Each approach has its unique characteristics and utility, and we have chosen the more compartmentalized approach to facilitate mapping, field identification, and information storage for management use. The types are first conceptualized as recognizable plant assemblages which are duplicated on similar sites. Following recognition, names are chosen to facilitate communication.

The foregoing discussion illustrates two additional important concepts that users should consider: (1) naming types is a process distinct from defining them, and (2) disagreement with a name or what it may connote to different individuals should not automatically raise questions about validity of the type definitions.

METHODS

Sampling

Field methods in this classification follow an earlier study plan.[4] They are similar to those described in Moir and Ludwig (1979, 1983), Pfister and Arno (1980), and Hanks et al. (1983). All of these relied on Daubenmire's (1952) methods. A reconnaissance method was used in which all environmentally and vegetationally different areas were sampled. Circular plots 0.093 acre (375 m^2) were subjectively located to ensure environmental homogeneity within the plot. Where vegetation patchiness was of small enough scale, plots included both patch and gap phases of the mosaic. Numerous physical site characteristics were recorded, including slope, aspect, elevation, parent rock, and soil depth and texture. We also recorded crown cover for shrub and herb species, and stem diameter class for tree species. Stem counts by size class provided a better approximation of the ecological role of trees than did canopy cover.

Types previously identified by Moir and Ludwig (1979) or Hanks et al. (1983) were sampled only enough to document their existence. Some plot data from their work were analyzed as part of this study when the plots occurred within the study area.

Data Analysis

We used successive approximations to classify stands as described by Pfister and Arno (1980), Moir and Ludwig (1983), DeVelice et al. (1986), and others. Several dif-

ferent approaches toward classification were tried, including: (1) grouping by dominance according to strata, (2) site factors, (3) presence or consistency of plant unions, (4) presence of any one of several species having approximately similar patterns of occurrence with respect to site factors, and (5) patterns observed in ordinations (Orloci 1966).

We carefully examined site characteristics within groups in the intermediate classifications, identifying those plots with nonconforming environments. We used mathematical ordinations to judge and illustrate quantitative consistency within and between types.

We compared our classification with others previously published (Moir and Ludwig 1979), or in various stages of completion at that time (Hanks et al. 1983; Alexander et al. 1984a, 1984b, 1986; DeVelice et al. 1986). We reconciled differences between classifications in order to provide the most logical units with respect to local and regional patterns. Thus, changes from type descriptions and nomenclature presented by Moir and Ludwig (1979) and Hanks et al. (1983) should be viewed as refinement of previous work based on addition of more data. Changes usually involved small differences in definition and some shifting of their plots from one type to another. When deemed advisable to prevent confusion, we assigned a new name.

Twenty-four of the 55 habitat types, phases, and community types in Appendix D are represented by 4 or fewer plots each, but only 5 of the 24 may be considered undersampled types. Fourteen are habitat types or phases described by the authors cited above. The existence of these 14 habitat types in the present study area was established by a few plots in order to reduce cost. Although we could not describe the full range of variability of these types within the study area, one or more of the above studies adequately covered such variability. In 10 cases, the other study included all or part of the present study area, as well as other locations.

Of the remaining 10 subdivisions having small sample sizes, 5 are unique but uncommon phases of more widespread habitat types, and 5 are separate, unique habitat types encountered too infrequently to sample adequately. We considered these types to be sufficiently distinct and to exhibit such a potential importance for management to identify them at this time.

Compensating factors often caused one type to occur on different slopes, aspects, or elevations. We did not subdivide such types unless there was an obvious difference in the plant community. Such subdivisions, including soils information, would increase specificity of the types for management application, and generally are accomplished by the Terrestrial Ecosystems Surveys (U.S. Forest Service 1983).

Successional stages of habitat types require more study before they can be identified, but successional trends that we observed are noted in this publication.

Naming the Types

New habitat types were named based on diagnostic characteristics. Those species with high fidelity or high mean abundance within a habitat type were chosen for the nomenclature of a habitat type. Whenever possible, habitat type names and keys utilized the names of plant species that were ecologically significant. However, this procedure was not always practical. Therefore, while some degree of importance can be attached to plants identified in the names and keys, they should not be considered the only ones of importance, or even the most important. Indeed, plants identified in the name of a type may occasionally be absent from some sites representative of the type. A list of all plants identified in the study is shown in appendix B.

There appears to be a gradient of growth form, stand characteristics, and fire response in *Quercus gambelii* from west to east along the "V" previously mentioned from northwestern Arizona to the Gila National Forest and up through the Rocky Mountains. We recognized this gradient between habitat types in the Rocky Mountains and Arizona in separating some habitat types. For example, the Rocky Mountain *Pinus ponderosa/Quercus gambelii* habitat type (DeVelice et al. 1986) is found in a broad geographical area northward and eastward from our study area. Hanks et al. (1983), however, used *Quercus gambelii* in Arizona to identify phases of several *Pinus ponderosa* habitat types. Their approach appears to be equally well-founded, and the resulting plant associations may be found over a large area northwestward from the present study.

In this study, it seemed appropriate to retain the nomenclature procedure of Hanks et al. (1983), using *Quercus gambelii* to identify phases, as well as having the species designate a habitat type as is appropriate in the southern Rocky Mountains (DeVelice et al. 1986). The treatment of *Quercus gambelii* is exemplary of other species as well, and illustrates the transitional nature of the study area. Large areas adjacent to the Gila National Forest contain distinctly different *Quercus gambelii* ecotypes, which happen to merge in the Gila National Forest. Distinguishing transitional habitat types identified in this study from those that are typically found in the southern Rocky Mountains and Arizona was somewhat arbitrary. For example, one grouping was named with *Quercus gambelii* as a habitat type descriptor, while its neighbor in the transition zone was named with *Quercus gambelii* as a phase descriptor.

We followed Hanks et al. (1983) in naming the *Pinus ponderosa/Arctostaphylos pungens* community type (c.t.). The PIPO/ARPU c.t. is a fire disclimax, at least within our study area, and does not warrant habitat type status.

Users of this classification should reference Lehr (1978), Weber and Johnson (1979), Martin and Hutchins (1980), or Lehr and Pinkava (1980, 1982) to identify their plant specimens. We used the name favored by the majority of the above references, listing other names as synonyms (Appendix B). When all three authors classified plants differently, we used Martin and Hutchins (1980) as reference. In a few instances, synonomy was confirmed by the National List of Scientific Plant Names (USDA 1982a, 1982b). In the few situations where we did not distinguish between two closely related species, the name of the more widespread one was used. We used

Carex foenea to designate and include other rhizomatous species, such as *C. praegracilis*, that are difficult to distinguish. Similarly, we grouped the shorter caespitose sedges as *Carex rossii* and included *Pinus discolor* with *Pinus edulis*. Nickerson et al. (1976) was the authority for common names.

DESCRIPTIONS OF HABITAT TYPES

The following descriptions provide characteristic features for each habitat type and phase identified in the study (table 1), with some tentative management implications. The descriptions should be sufficient, in most cases, to confirm the habitat type that was derived from the keys shown in Appendix A. When descriptions contain too little information to confirm doubtful stands, reference to the successional status of trees (Appendix C) and to the summary association tables (Appendix D) may be helpful. Descriptions are arranged according to series and habitat type. Local topography, microclimate, and soil moisture relationships often cause reversal of the normal elevational order (fig. 2), even at the series level.

Picea engelmannii Series

Picea engelmannii/Moss habitat type (PIEN/Moss; Engelmann spruce/moss)

This type was found at the summit of Black Mountain (Mogollon Mountains, Gila National Forest) and in the San Mateo Mountains, Cibola National Forest.

Vegetation.—*Picea engelmannii* is the dominant tree, with *Pseudotsuga menziesii* sometimes important as a seral tree. Seral or minor trees may include *Abies concolor* and *Pinus strobiformis*. Undergrowths are characteristically sparse, even in small openings and under relatively open canopies. *Vaccinium* spp., if present, provide less than 2% cover. Herbs are infrequent. Lichens and mosses are abundant at microsites that are not covered by deep, extensive litter.

Physical setting.—We found this type on summits, ridgetops, and dry, upper slopes subject to deep persistent snowpacks (fig. 3). Elevations in the San Mateo Mountains are 9,500–10,000 feet (2,896–3,048 m), with cryic soil temperatures.

Adjacent habitat types.[6]—The PIEN/Moss HT usually is bordered by the ABLA/VAMY HT on more sheltered or wetter sites, by the PSME/FEAR HT on ridgetops, and by the ABCO/ACGL HT on lower slopes.

Discussion.—In our study area this habitat type apparently is found only within established wilderness areas. Our late seral plots varied from those described by Moir and Ludwig (1979) in the codominance of *Pseudotsuga menziesii* and absence of *Abies lasiocarpa*. Seral stages include abundant *Acer glabrum* and *Jamesia americana* in the undergrowth. Postdisturbance succes-

[6]*Only the major, commonly observed relationships are described in this publication.*

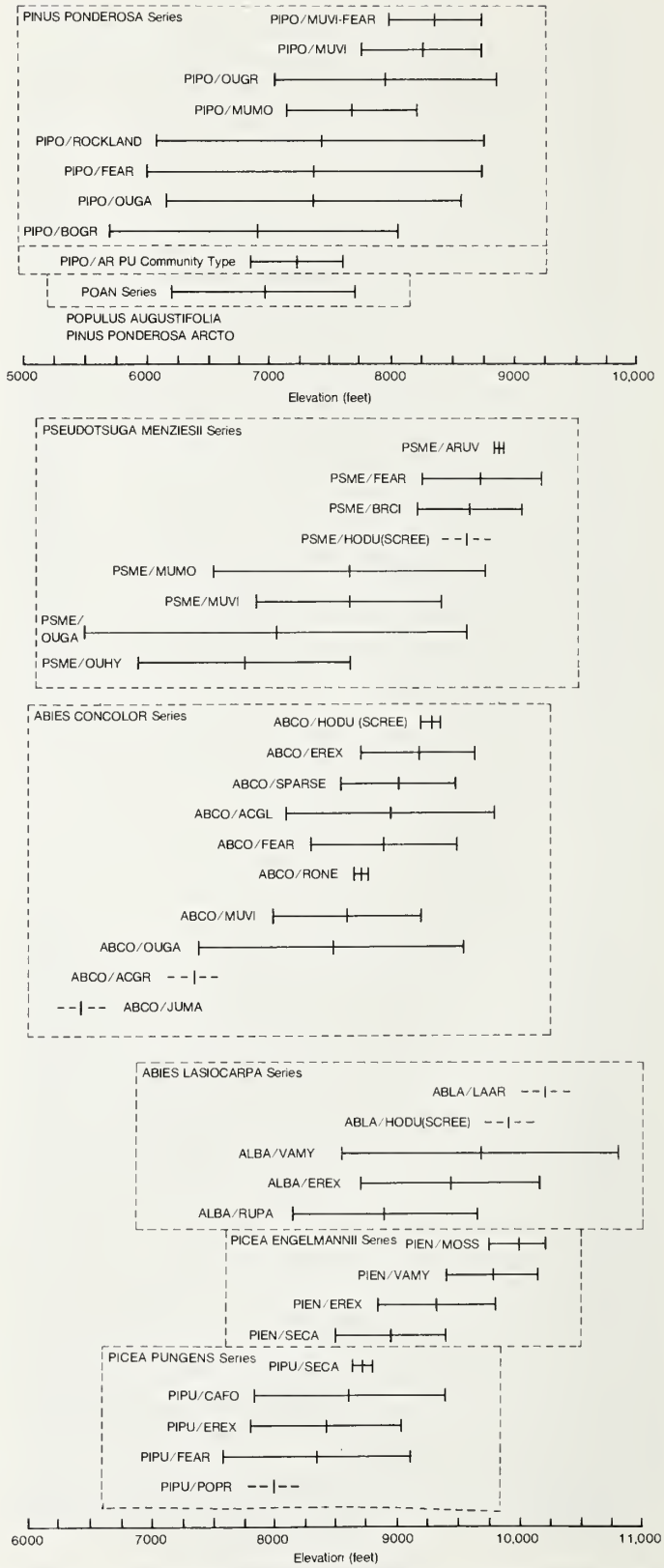

Figure 2.—General elevational relationship of forest habitat types in the study area. (The upper and lower elevations for each type are data from individual sample plots, respectively; the midpoint of the elevational range is denoted by a vertical bar, except for habitat types sampled by a single plot, where the unknown range is indicated by a dotted line and one bar is the plot elevation.)

Table 1.—List of habitat types and plant communities identified on the Apache, Gila, and part of the Cibola National Forests

Habitat Type Name	Abbreviation
Picea engelmannii Series	
Picea engelmannii/Moss habitat type	PIEN/Moss HT
Picea engelmannii/*Vaccinium myrtillus* habitat type	PIEN/VAMY HT
Picea engelmannii/*Senecio cardamine* habitat type	PIEN/SECA HT
Abies lasiocarpa phase	ABLA phase
Abies concolor phase	ABCO phase
Picea engelmannii/*Erigeron eximius* habitat type	PIEN/EREX HT
Abies lasiocarpa Series	
Abies lasiocarpa/*Vaccinium myrtillus* habitat type	ABLA/VAMY HT
Vaccinium myrtillus (typic) phase	VAMY (typic) phase
Rubus parviflorus phase	RUPA phase
Abies lasiocarpa/*Lathyrus arizonicus* habitat type	ABLA/LAAR HT
Abies lasiocarpa/*Holodiscus dumosus* (Scree) habitat type	ABLA/HODU (Scree) HT
Abies lasiocarpa/*Erigeron eximius* habitat type	ABLA/EREX HT
Abies lasiocarpa/*Rubus parviflorus* habitat type	ABLA/RUPA HT
Picea pungens Series	
Picea pungens/*Senecio cardamine* habitat type	PIPU/SECA HT
Picea pungens/*Erigeron eximius* habitat type	PIPU/EREX HT
Picea pungens/*Carex foenea* habitat type	PIPU/CAFO HT
Picea pungens/*Festuca arizonica* habitat type	PIPU/FEAR HT
Picea pungens/*Poa pratensis* habitat type	PIPU/POPR HT
Abies concolor Series	
Abies concolor/*Erigeron eximius* habitat type	ABCO/EREX HT
Abies concolor/(Sparse) habitat type	ABCO/Sparse HT
Abies concolor/*Holodiscus dumosus* (Scree) habitat type	ABCO/HODU (Scree) HT
Abies concolor/*Acer glabrum* habitat type	ABCO/ACGL HT
Abies concolor/*Muhlenbergia virescens* habitat type	ABCO/MUVI HT
Abies concolor/*Quercus gambelii* habitat type	ABCO/QUGA HT
Quercus gambelii (typic) phase	QUGA (typic) phase
Muhlenbergia virescens phase	MUVI p.
Abies concolor/*Robinia neomexicana* habitat type	ABCO/RONE HT
Abies concolor/*Festuca arizonica* habitat type	ABCO/FEAR HT
Festuca arizonica (typic) phase	FEAR (typic) phase
Poa fendleriana phase	POFE p.
Abies concolor/*Acer grandidentatum* habitat type	ABCO/ACGR HT
Abies concolor/*Juglans major* habitat type	ABCO/JUMA HT
Pseudotsuga menziesii Series	
Pseudotsuga menziesii/*Arctostaphylos uva-ursi* habitat type	PSME/ARUV HT
Pseudotsuga menziesii/*Holodiscus dumosus* (Scree) habitat type	PSME/HODU (Scree) HT
Pseudotsuga menziesii/*Festuca arizonica* habitat type	PSME/FEAR HT
Pseudotsuga menziesii/*Bromus ciliatus* habitat type	PSME/BRCI HT
Pseudotsuga menziesii/*Quercus gambelii* habitat type	PSME/QUGA HT
Quercus gambelii (typic) phase	QUGA (typic) phase
Muhlenbergia virescens phase	MUVI phase
Festuca arizonica phase	FEAR phase
Pseudotsuga menziesii/*Muhlenbergia virescens* habitat type	PSME/MUVI HT
Pseudotsuga menziesii/*Muhlenbergia montana* habitat type	PSME/MUMO HT
Pseudotsuga menziesii/*Quercus hypoleucoides* habitat type	PSME/QUHY HT
Pinus ponderosa Series	
Pinus ponderosa/*Muhlenbergia virescens* habitat type	PIPO/MUVI HT
Muhlenbergia virescens (typic) phase	MUVI (typic) phase
Quercus gambelii phase	QUGA phase
Pinus ponderosa/*Muhlenbergia virescens-Festuca arizonica* habitat type	PIPO/MUVI-FEAR HT
Muhlenbergia virescens-Festuca arizonica (typic) phase	MUVI-FEAR (typic) phase
Quercus gambelii phase	QUGA phase
Bouteloua gracilis phase	BOGR phase
Pinus ponderosa/*Quercus grisea* habitat type	PIPO/QUGR HT
Muhlenbergia montana phase	MUMO phase
Muhlenbergia longiligula phase	MULO phase
Pinus ponderosa/Rockland habitat type	PIPO/Rockland HT
Pinus ponderosa/*Festuca arizonica* habitat type	PIPO/FEAR HT
Festuca arizonica (typic) phase	FEAR (typic) phase
Quercus gambelii phase	QUGA phase
Bouteloua gracilis phase	BOGR phase
Pinus ponderosa/*Muhlenbergia montana* habitat type	PIPO/MUMO HT
Pinus ponderosa/*Quercus gambelii* habitat type	PIPO/QUGA HT
Quercus gambelii (typic) phase	QUGA (typic) phase
Muhlenbergia longiligula phase	MULO phase
Pinus ponderosa/*Bouteloua gracilis* habitat type	PIPO/BOGR HT
Pinus edulis phase	PIED phase
Vitis arizonica phase	VIAR phase
Pinus ponderosa/*Arctostaphylos pungens* Community Type	PIPO/ARPU CT
Populus angustifolia series	POAN series

sion begins with a *Populus tremuloides/Pseudotsuga menziesii* community, converting to a stand containing only *Pseudotsuga menziesii*, and then to the late seral mixed codominance stage. The type represents poor site quality for *Pseudotsuga menziesii*.

Picea engelmannii/Vaccinium myrtillus habitat type (PIEN/VAMY; Engelmann spruce/Rocky Mountain whortleberry)

We found the PIEN/VAMY HT in the San Mateo Mountains, Magdalena Ranger District, Cibola National Forest.

Vegetation.—The PIEN/VAMY HT may be recognized by the absence of *Abies lasiocarpa* and the strong competitive presence of *Picea engelmannii*—which in our plots totaled at least 170 stems per acre in the regeneration class.[7] *Pseudotsuga menziesii* was present, and sometimes even dominated seral stands. *P. menziesii* regeneration occurs, but was much less vigorous than that of *Picea engelmannii*.

The undergrowth was dominated by a low shrub layer always containing *Vaccinium myrtillus* (fig. 4), with *Lonicera utahensis*, *Physocarpus monogynus*, and *Ribes pinetorum* often present. The tall shrubs, *Acer glabrum*, *Jamesia americana*, and *Salix scouleriana* often were present.

Herbaceous vegetation was sparse, with few species having more than 1% coverage. Species often present included: *Bromus ciliatus*, *Goodyera repens*, *Erigeron eximius*, *Pyrola chlorantha*, and *Ramischia secunda*.

The PIEN/VAMY HT differs from the ABLA/VAMY HT in the absence of *Abies lasiocarpa*, the relatively sparse (30% or less) coverage of *Vaccinium myrtillus*, and greater seral importance of *Pseudotsuga menziesii*.

Physical setting.—The PIEN/VAMY HT occurs on cold sites where snow persists late into the spring, but the sites may be drier and warmer than in the ALBA/VAMY HT. We found the PIEN/VAMY HT from 9,400 to 10,150 feet (2,865 to 3,093 m) elevation on north and northeast slopes with gradients of 30% to 60%. It was on upper slopes except at the lowest elevation, where it was found in a draw. Soils were very cobbly.

[7] *Regeneration and reproduction are used synonymously to denote trees that are less than 4.5 feet (1.37 m) tall.*

Figure 3.—*Picea engelmannii*/Moss habitat type. Teepee Peak, San Mateo Mountains, 9,970 feet (3,038 m) elevation. Upper slope and ridgetop sites with deep, persistent snowpack support an undergrowth dominated by moss, lichen, and litter.

Figure 4.—*Picea engelmannii/Vaccinium myrtillus* habitat type. Cub Spring, San Mateo Mountains, 9,400 feet (2,865 m) elevation. *Picea engelmannii* and shrubs dominate, with *Vaccinium myrtillus* prominent.

Adjacent habitat types.—Ridgetops support the PIEN/MOSS or PSME/FEAR HT's. Cobble-scree soils below the PIEN/VAMY HT support the ABCO/ACGL HT. On warmer sites the PIEN/VAMY HT adjoins mixed conifer habitat types.

Discussion.—Several authors working in the Southwest and elsewhere have described habitat types involving various combinations of *Picea engelmannii*, *Abies lasiocarpa*, *Vaccinium myrtillus*, *Vaccinium scoparium* (VASC), and *Polemonium pulcherrimum* (POPU) or *Polemonium delicatum* (PODE) (Moir and Ludwig 1979, Youngblood and Mauk 1985, Alexander et al. 1986, DeVelice et al. 1986, and others). Our PIEN/VAMY HT appears more closely related in site characteristics and floristics to habitat types in the *Abies lasiocarpa* series, with a *Vaccinium myrtillus* or *V. scoparium* undergrowth, than to the near-tundra PIEN/VAMY/POPU HT of DeVelice (1986). However, one of our plots was reminis-

cent of the latter type, as described by Moir and Ludwig (1979) under the name PIEN/VASC/PODE. Our PIEN/VAMY HT differs from the above types in that it lacks *Abies lasiocarpa* and has less herbaceous and low shrub cover.

Crown fires result in successional stages dominated by *Populus tremuloides* and a dense herbaceous layer. The cold, snowy sites limit timber management opportunities, but proper harvesting and grazing techniques can increase water production and quality.

Picea engelmannii/Senecio cardamine habitat type (PIEN/SECA; Engelmann spruce/cardamine groundsel)

We found this type only in the vicinity of Hannagan and Thomas Creek drainages, Blue Mountains, Apache National Forest, and Bearwallow Mountain, Mogollon Mountains, Gila National Forest.

Vegetation.—The overstory is a mixture of *Pseudotsuga menziesii* and *Picea engelmannii*, frequently with *Picea pungens*, *Abies concolor*, *A. lasiocarpa*, *Pinus strobiformis*, and *Populus tremuloides*. Tree regeneration is mostly *Picea engelmannii* and/or *Abies lasiocarpa* or *A. concolor*. The combined number of stems less than 10 inches (25.4 cm) d.b.h. of *Picea engelmannii* and *Abies lasiocarpa* usually exceeds that of combined *Abies concolor* and *Pseudotsuga menziesii* by a ratio greater than about 2:1 in most stands.

The undergrowth is characteristically herbaceous often with conspicuous patches of *Senecio cardamine* (fig. 5). Other common herbs include *Pteridium aquilinum*, *Dugaldia hoopesii*, *Viola canadensis*, *Senecio wootoni*, *Geranium richardsonii*, *Fragaria ovalis*, *Bromus ciliatus*, *Erigeron eximius*, *Ramischia secunda*, and *Pyrola chlorantha*.

Shrubs are minor; the most constant species are *Lonicera utahensis* and *Rubus parviflorus*.

Moir and Ludwig (1979) described two phases. When *Abies lasiocarpa* has light to moderate regeneration, it is used as the phase name. When it is absent or sparse and *A. concolor* has light to moderate regeneration, the latter species designates the phase. *Pachistima myrsinites* often is found in the *Abies concolor* phase, while *Lonicera utahensis* is present in both phases but is found less often in the *Abies concolor* phase. Other shrubs may be present. *Mertensia franciscana* and *Fragaria americana* are sometimes present in the *Abies concolor* phase but are absent in the *Abies lasiocarpa* phase.

Figure 5.—*Picea engelmannii/Senecio cardamine* habitat type. Turkey Creek drainage, Mogollon Mountains, 9,400 feet (2,865 m) elevation. Undergrowth typically herbaceous, often with conspicuous patches of *Senecio cardamine* or the low shrub, *Pachistima myrsinites*.

Physical setting.—Mean annual precipitation is about 29 inches (74 cm) (Beschta 1976). Elevations range from 8,500 to 9,400 feet (2,590 to 2,865 m) mostly on gentle slopes. The *Abies lasiocarpa* phase occurs on north and east aspects mostly at 9,000 feet (2,743 m) and above, often on upper slopes and ridges, and the *Abies concolor* phase tends to be found on slightly warmer northerly aspects, steeper slopes, and lower positions on the slope. According to the Terrestrial Ecosystem Survey, the soils are of basaltic origin, moderately deep to deep, and with a fine-loamy or loamy-skeletal texture (U.S. Forest Service 1983). They are classed as mixed, Mollic Cryoboralfs near the warm margin of the cryic soil temperature regime.

Adjacent habitat types.—Habitat types at lower elevations are ABCO/QUGA, ABCO/Sparse, and PIPU/FROV. Stands intergrading with the PIPU/SECA HT can be found. At higher elevations, the ABLA/EREX HT may adjoin this type.

Discussion.—Streamside sites in the *Abies concolor* phase could be separated into another phase having more mesic forbs, but there were too few plots for good definition. Although geographically limited, the PIEN/SECA HT has close environmental and floristic relationships to other habitat types that display essentially herb-rich undergrowths at the low elevation, warm border of the spruce-fir region. These include the ABLA/VAMY, RUPA phase, ABLA/EREX, and PIPU/EREX HT's.

Cessation of fires in the last 50 years is evident by increased numbers of shade tolerant *Picea engelmannii* and *Abies lasiocarpa* in the undergrowth. Generally this habitat type has a fire history characterized by frequent, low intensity fires as well as larger, more intense, surface fires at a mean interval of about 22 years (Dieterich 1983). However, our sites were undisturbed by fire within the past 50 years. Centuries of such fire history help explain the mixtures of such seral species as *Populus tremuloides*, *Pinus ponderosa*, *P. strobiformis*, and *Pteridium aquilinum*.

The PIEN/SECA HT is found on sites that are of high quality for tree growth. However, windthrow could be a problem following logging, as indicated by its natural occurrence in undisturbed stands. Five-year growth and development was studied by Gottfried (1978) in an undisturbed, old-growth stand within this habitat type. The abundance of forbs in this type indicates greater utility for sheep or deer forage than for cattle. The PIEN/SECA HT is esthetically important because of the variety of species present at relatively low, accessible locations.

Picea engelmannii/Erigeron eximius habitat type (PIEN/EREX; Engelmann spruce/forest fleabane)

The PIEN/EREX HT (fig. 6) is widely distributed throughout the study area. Our plots were along the Mim-

bres River, and in the Black Range, Mogollon Mountains, and White Mountains of the Apache and Gila National Forests. The Springerville, Alpine, Reserve, Glenwood, and Mimbres Ranger Districts were represented.

Vegetation.—*Picea engelmannii* and/or *Pseudotsuga menziesii* are climax dominants. *Abies concolor* and *Pinus strobiformis* are minor climax and seral trees respectively, which are sometimes abundant as reproduction, but never in the larger size classes. *Populus tremuloides* is a major seral species. *Abies lasiocarpa* and *Pinus ponderosa* are accidental in mature stands, the former occurring only as reproduction. *P. ponderosa* is an early seral tree in this habitat type, occurring as an occasional mature tree in some stands.

Stands lacking *Picea pungens* may have less than 14% graminoid cover, less than 30% forb cover, and less than 45% total herbaceous cover. On more gentle slopes, *Erigeron eximius* increases to 20% cover. Where *Picea pungens* is a minor climax tree, herbaceous cover is greater in all three categories.

Shrubs are unimportant, having less than 7% cover in our plots. *Rubus parviflorus* often is present.

Graminoids usually have less coverage than do forbs, and in our plots graminoid coverage ranged from 7% to 52%. *Bromus ciliatus* and *Carex foenea* were dominants, with the former always present. Both caespitose and rhizomatous sedges usually were present.

Forbs covered 19–102% of the area (higher coverage represents overlapping layers). *Geranium richardsonii* and *Lathyrus arizonicus* always were present. These two were dominant in some plots as were *Erigeron eximius*, *Senecio bigelovii*, *Smilacina stellata*, and *Thalictrum fendleri*. Other plants frequently present included *Fragaria ovalis*, *Haplopappus parryi*, *Ligusticum porteri*, *Osmorhiza depauperata*, *Pseudocymopteris montanus*, *Vicia americana*, and *Viola canadensis*.

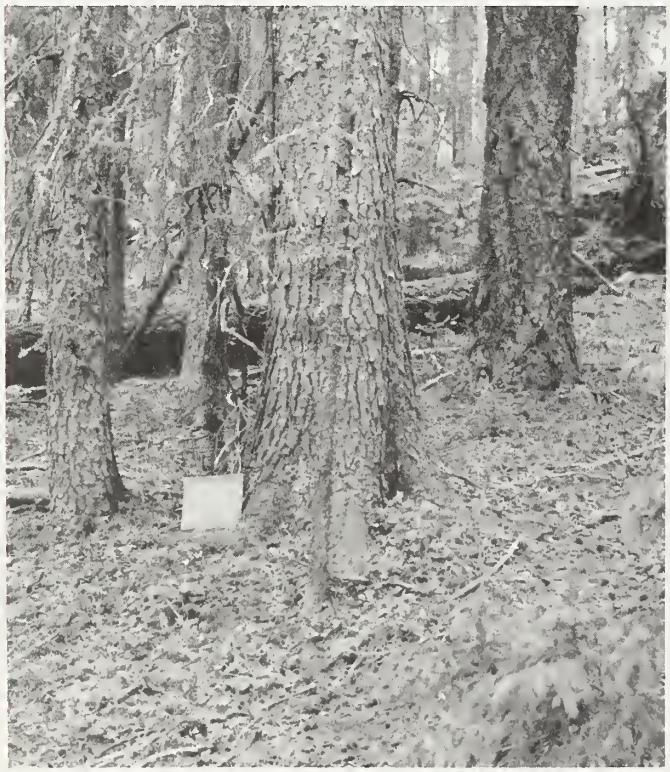

Figure 6.—*Picea engelmannii/Erigeron eximius* habitat type. Quaking Aspen Creek, Mogollon Mountains, 9,040 feet (2,755 m) elevation. *Picea engelmannii*, *Pseudotsuga menziesii*, and grasses or forbs characterize these sites at the lower edge of *Picea engelmannii-Abies lasiocarpa* forests.

Physical setting.—The PIEN/EREX HT occurs from 8,850 to 9,800 feet (2,697 to 2,987 m) elevation at the lower, warmer zone of the *Picea engelmannii* elevational range. *Picea pungens* occurs throughout the entire elevational range of the habitat type, on all aspects, and with slopes varying from 7% to 50%. Stands without *Picea pungens* occur mostly on northeast exposures of steep middle to lower slopes (28–50%) above 9,000 feet (2,743 m).

Adjacent habitat types.—Moister sites in the White Mountains support the PIEN/SECA HT, while the PSME/BRCI HT sometimes is intermixed with the PIEN/EREX HT. Stands at lower and drier sites are composed of ABCO/MUVI, PIPU/FEAR, ABCO/Sparse, or PIPU/EREX HT's.

Discussion.—The PIEN/EREX HT includes some plots assigned by Moir and Ludwig (1979) to their *Picea pungens-Picea engelmannii/Erigeron superbus* habitat type The remaining plots were assigned to the *Picea pungens/Erigeron eximius* habitat type.

Populus tremuloides may be expected to occupy a site following clearcutting, but *Picea engelmannii* regenerates readily under a canopy. Logging resulted in the establishment of *Abies concolor*, *Pteridium aquilinum*, and *Carex foenea*. We noted witches brooms on large *Pseudotsuga menziesii* and *Picea engelmannii*. Elk used the habitat type heavily.

Abies lasiocarpa Series

Abies lasiocarpa/Vaccinium myrtillus habitat type (ABLA/VAMY; subalpine fir/Rocky Mountain whortleberry)

The typic phase was sampled in the White Mountains and on Escudilla Mountain, Apache National Forest, Arizona, and in the Mogollon Mountains, Gila National Forest, New Mexico. The *Rubus parviflorus* phase was sampled in the Mimbres and Mogollon Mountains of the Gila National Forest.

Vegetation.—*Picea engelmannii* and *Abies lasiocarpa* usually are codominant, both producing abundant regeneration. However, in some stands, one of these species can be dominant, the other minor. *Pseudotsuga menziesii* is found occasionally at lower elevations where it can be a seral tree, achieving codominance on individual sites, but with little regeneration evident. *Populus tremuloides* is a common seral tree.

The undergrowth characteristically is dominated by *Vaccinium myrtillus*. Its cover usually exceeds 30%, but may be as low as 2% (fig. 7). Other common shrubs are *Lonicera involucrata*, *L. utahensis*, *Ribes wolfii*, and *Sorbus dumosa*.

Herbs have less coverage than shrubs, but common species include *Bromus ciliatus*, *Epilobium angustifolium*,

Erigeron eximius, *Fragaria ovalis*, *Haplopappus parryi*, *Luzula parviflora*, *Moneses uniflora*, *Pedicularis angustifolia*, *P. racemosa*, and *Ramischia secunda*.

In the *Rubus parviflorus* phase, *Pseudotsuga menziesii* and *Abies concolor* are seral and may have some regeneration potential, but the relatively few individuals are vastly exceeded by the regeneration densities of the two climax species. *Pinus strobiformis* is found occasionally. There is a well developed shrub assemblage in the *Rubus parviflorus* phase in which *Vaccinium myrtillus* usually is dominant and *Rubus parviflorus* usually exceeds 5% cover. Herbaceous cover is luxuriant (averaging 15–20%) and well represented by such species as *Artemisia franserioides*, *Epilobium angustifolium*, *Erigeron eximius*, *Geranium richardsonii*, *Haplopappus parryi*, *Ramischia secunda*, *Swertia radiata*, and *Viola canadensis*.

Physical setting.—The ABLA/VAMY HT, VAMY phase is found on all slopes and aspects above 9,500 feet (2,896 m) elevation. Stands in the White Mountains are found within the mean annual precipitation isohyets of 30–35 inches (76–89 cm) (Beschta 1976). The ABLA/VAMY HT is part of a circumboreal family of subalpine-subpolar forests (taiga) characterized by deep snowpack and brief, cool summers. Snow course data for 17 years of record from two stations between 10,500 and 10,800 feet (3,200 and 3,292 m) in the Mogollon Mountains reveal mean snow depths of 37–51 inches (94–130 cm) by around February 1, increasing to 47–72 inches (119–183 cm) by around April 1 (Jones 1981). The water equivalency of this snowpack is about 12 inches (30 cm) in February and 20 inches (51 cm) by April. Greater snow depths and water equivalents are reported between 10,900 and 11,200 feet (3,320 and 3,414 m) in the White Mountains (Jones 1981). These data represent snow conditions in the typic phase, but mostly within forest openings rather than under tree canopies.

Figure 7.—*Abies lasiocarpa/Vaccinium myrtillus* habitat type, typic phase. This type, found between 9,560 and 10,800 feet (2,913 and 3,291 m) elevation, is characterized by rich and diverse shrub and forb layers. Site quality for timber varies with aspect and soil type, and is sometimes poor.

Soils can be extremely cobbly or extremely stony, tending toward scree. Soil temperature regimes are toward the colder portions of the cryic spectrum. In the White Mountains, the soils have been described as Dystric Cryochrepts, loamy-skeletal, mixed, cold.[8]

The *Rubus parviflorus* phase commonly is on lower slopes, in draws, or on streamsides of northerly exposures around 8,500–9,600 feet (2,591–2,926 m) elevation. It can be found on upper slopes as high as 10,320 feet (3,146 m). Soils specific to the ABLA/VAMY h.t, RUPA phase have not been described, nor are snow course data available. However, the typical phase occurs on cooler sites with deeper snowpack than the *Rubus parviflorus* phase. The soils of the RUPA phase are deep or moderately deep, and sometimes very, or even extremely, cobbly. They are apparently within the warmer portions of the cryic soil temperature spectrum and appear sufficiently moist during the growing season, so that plants, especially the undergrowth, are under little or no moisture stress.

Adjacent habitat types.—On cold, dry ridgetops and upper slopes, the PIEN/MOSS or PSME/FEAR HT's occur adjacent to the ABLA/VAMY HT. However, most ecotones occur in warmer environments and at lower elevations, specifically with the ABCO/ACGL HT (on warm sites with extremely cobbly soils), the ABLA/RUPA HT, and the ABLA/EREX HT. The latter habitat type can also form mosaics, intergrading with stands of the ABLA/VAMY HT. Some of the environmental subtleties that account for these habitat types are unclear. However, some of the relationships are listed below:

Vegetation	Elevation—ft (m)	Position on Slope
ABLA/VAMY HT,	>9,500 (>2,913 m)	Mid and upper
VAMY phase	8,900–10,200	Upper to lower
ABLA/EREX HT	(2,713–3,109 m)	
ABLA/VAMY HT,	8,700–10,320	Upper to lower
RUPA phase	(2,651–3,146 m)	
ABLA/RUPA HT	8,140–9,640	Mid, lower, and stream-
	(2,481–2,938 m)	side benches

Discussion.—Much of this habitat type occurs in the Gila and Baldy Wilderness Areas. The environmental and productive variability of the type has been discussed by Moir and Ludwig (1979) within their *Abies lasiocarpa/Vaccinium scoparium* habitat type (ABLA/VASC HT)—they indicate that timber productivity varies greatly depending on site. One of the most important overall management considerations is the value of this habitat type for snow catchment and water production. The ABLA/VAMY HT is, we believe, the most important of

[8] *U.S. Department of Agriculture, Forest Service. 1982. Progress review of Terrestrial Ecosystems Survey of Springerville Ranger District. Unpublished evaluation report (letter July 2, 1982, 2550, including mapping legend).*

all the subalpine types in this region for winter snow accumulation and regulated summer discharge of water. The principles and application of watershed management summarized by Leaf (1975a, 1975b) and Hibbert (1979) seem to apply to the ABLA/VAMY HT.

A ridgetop site in the *Rubus parviflorus* phase in a late successional stage following fire included such species as *Acer glabrum*, *Salix scouleriana*, *Populus tremuloides*, *Holodiscus dumosus*, and abundant *Robinia neomexicana*; *Picea engelmannii* and *Abies lasiocarpa* reproduction and large, mature *Pseudotsuga menziesii*, which survived the fire, also were observed. Ground vegetation was similar to climax, but sparser.

The floristics of this habitat type reveal a strong affinity to other *Vaccinium*-dominated subalpine forests. There is much evidence that during the Pleistocene such forests were more continuous and widespread along the Rocky Mountain Cordillera and through the Basin and Range Physiographic Province. Although these forests are southern geographic outliers, the environment characterizing them is still typically that of the boreal, subalpine forest to which the Cordilleran flora is well adapted. Therefore, relatively few southern or Madrean species are found, the most notable exception being *Pedicularis angustifolia*. The related ABLA/VASC HT described most recently by Mauk and Henderson (1984) is sufficiently different in species composition to be classified as a different habitat type.

Where the *Rubus parviflorus* phase occurs adjacent to streams, *Cornus stolonifera* may dominate at the streamside, and the habitat type may show some affinity to the *Picea pungens/Cornus stolonifera* habitat type of Alexander et al. (1986). Youngblood and Mauk (1985) identified an ABLA/VAMY HT in Utah that appears to be similar to our typic phase, as did DeVelice et al. (1986) in northern New Mexico and southern Colorado. The greatest difference between the Utah type and that in New Mexico and Colorado is the absence of *Populus tremuloides* in seral stands in Utah. Perhaps the Utah type of Youngblood and Mauk should be considered a different phase of the habitat type.

The *Rubus parviflorus* phase has similarities to both the ABLA/RUPA and ABLA/EREX HT's. The ages of sampled stands were similar. Gradients exist between these types and the ABLA/VAMY HT, RUPA phase, and the classification divisions among them are somewhat arbitrary. Furthermore, the ABLA/VAMY HT, RUPA phase is related to the extensive *Abies lasiocarpa/Vaccinium myrtillus-Linnaea borealis* (ABLA/VAMY-LIBO) and *Abies/lasiocarpa/Vaccinium myrtillus-Rubus parviflorus* (ABLA/VAMY-RUPA) habitat types, which are distinct at low elevations in northern New Mexico from the ABLA/VAMY HT (DeVelice et al. 1986). The ABLA/VAMY HT, RUPA phase has less dense forb cover than any of the northern New Mexico types containing *Abies lasiocarpa* and *Vaccinium myrtillus*. It has a closer relationship to the overstory of the ABLA/VAMY-LIBO HT and to the herbaceous layer of the ABLA/VAMY-RUPA HT

The *Rubus parviflorus* phase mostly occurs within wilderness areas in the National Forests included in this study. The rich and diverse canopy, shrub, and herbaceous layers make this phase an outstanding habitat for deer, elk, and numerous birds. Because of low grass production compared to forbs, the value for cattle grazing would be limited, but that for sheep would be high.

Abies lasiocarpa/Lathyrus arizonicus habitat type (ABLA/LAAR; subalpine fir/Arizona peavine)

We found this type only on Whitewater Baldy, Mogollon Mountains, Gila National Forest, New Mexico (fig. 8). The type was described by Moir and Ludwig (1979) on the San Francisco Peaks in northern Arizona.

Vegetation.—*Pinus strobiformis* and *Pseudotsuga menziesii* dominate a stand which also contains *Abies lasiocarpa*, and sometimes *Picea engelmannii*. *Abies lasiocarpa* dominates regeneration. Moderate shrub and forb layers are typical, with *Acer glabrum*, *Symphoricarpos oreophilus*, *Lathyrus arizonicus*, and *Vicia americana* dominating.

Physical setting.—This type was inferred from one plot, which was located at 10,200 feet (3,108 m) elevation on a 52%, southeast-facing slope. It was near a mountain crest.

Adjacent habitat types.—This type occurs at the lower edge of the *Picea-Abies* zone and may adjoin stands dominated by *Abies concolor*, *Pseudotsuga menziesii*, *Abies lasiocarpa* or *Picea engelmannii*. It is related to the ABLA/HODU (Scree) HT, but with more soil between cobbles and, consequently, more herbaceous growth.

Discussion.—This type differs from the description of the ABLA/LAAR HT of Moir and Ludwig (1979) in having a lower elevational position relative to other spruce-fir stands and in the dominance of *Pinus strobiformis*. More study is needed to clarify the distinction between the ABLA/LAAR HT and the ABLA/EREX HT at the lower elevational limits of *Abies lasiocarpa*. Fire scars indicated that ground fires are infrequent, but a natural part of this community, and may influence the nature of the herbaceous vegetation.

Abies lasiocarpa/Holodiscus dumosus (Scree) habitat type (ABLA/HODU (Scree); subalpine fir/bush rockspirea (scree))

We found this type on Center Baldy in the Mogollon Mountains, Gila National Forest, but it probably occurs elsewhere in Arizona and New Mexico where site conditions are suitable.

Vegetation.—Our single plot was dominated by *Pseudotsuga menziesii*, with *Pinus strobiformis* and *Abies lasiocarpa* comprising the remainder of the overstory. All three species are climax components. Numerous shrubs were present, with *Symphoricarpos oreophilus*, *Juniperus communis*, and *Holodiscus dumosus* dominant. *Robinia neomexicana* also was conspicuous throughout the stand. Grasses and forbs were relatively minor, but 14 species were present; *Geranium richardsonii* had measurable cover.

Physical setting.—Our plot was at 9,900 feet (3,018 m) elevation on a 54%, south-facing slope. The type extended from the ridgetop to midslope or lower. The critical site factor is the loose rock surface (scree), which limits water storage for shallow-rooted plants (fig. 9).

Adjacent habitat types.—Our plot was adjacent to the ABLA/VAMY HT on the ridge, but the type extended below midslope and presumably contacted more mesic *Abies lasiocarpa* habitat types at lower positions on the slope.

Figure 8.—*Abies lasiocarpa/Lathyrus arizonicus* habitat type. This type—found in the Coconino National Forest and Whitewater Baldy, Mogollon Mountains, Gila National Forest—is related to the ABLA/HODU (Scree) HT, but with better soil and more herbaceous growth. The one plot sampled was at 10,200 feet (3,108 m) elevation.

Figure 9.—*Abies lasiocarpa/Holodiscus dumosus* (scree) habitat type. Talus from nearby cliffs is the featured soil parent material here. Note down logs from a very recent fire.

Discussion.—The loose rock surface stores solar heat and probably maintains a readily water-absorbent soil underneath, even during winter. Because snow melts more rapidly on the rock surfaces, the scree types are probably important for ground-water recharge. They also are important as rodent and reptile habitats, but not for commercial timber use. The *Abies lasiocarpa/Saxifraga bronchialis* habitat type in northern New Mexico (DeVelice et al., 1986) is in a virtually identical environment, although there are some significant differences in vegetation.

Abies lasiocarpa/Erigeron eximius habitat type (ABLA/EREX; subalpine fir/forest fleabane)

This type is widespread and common throughout the study area (fig. 10).

Vegetation.—*Picea engelmannii* and *Abies lasiocarpa* are climax dominants, exhibiting moderate to heavy *Abies lasiocarpa* or *Picea engelmannii* regeneration. *Abies lasiocarpa* regeneration ranges from 70 to 3,400 stems per acre (173 to 8,401 per ha). *Populus tremuloides* is a conspicuous seral tree. *Pseudotsuga menziesii* and *Abies concolor* may be present.

Shrubs cover from 0% to 20% of the area, but usually are a minor component of the community. *Lonicera utahensis* and *Rubus parviflorus* often are present, the latter covering 1% or less of the area. *Vaccinium myrtillus* usually is absent, or has less than 5% cover, much less than herbaceous cover.

The herbaceous undergrowth typically is dense, dominated by forbs with some graminoids, including *Haplopappus parryi*, *Geranium richardsonii*, *Bromus ciliatus*, *Lathyrus arizonicus*, and *Carex foenea*. *Erigeron eximius* is dominant in most stands, usually forming extensive clonal patches. Total forb cover is 10% to more than 100%, usually 20–75%.

Physical setting.—The ABLA/EREX HT is found over a wide range of slopes and aspects between 9,400 and 10,200 feet (2,860 and 3,100 m), and occasionally as low as 8,700 feet (2,651 m). Mean annual precipitation is about 30 inches (76 cm) (Beschta 1976). The forests are somewhat warmer and drier than those of the ABLA/VAMY HT, as indicated by snow course measurements from three stations near the low elevation (between 9,000 and 9,300 feet or 2,743 and 2,835 m) margin of the ABLA/EREX HT (Jones 1981). Data from these stations averaged over at least 13 years, show mean snow depths from both February 1 and April 1 measurement periods to be about 21 inches (53 cm). This is equivalent to about 6 inches (15 cm) of water. The modal environment for the ABLA/EREX HT lies between this minimum limit of winter snowpack and that described for the ABLA/VAMY HT.

Soils occupy the warmer portions of the cryic soil temperature spectrum. They are mostly deep to moderately deep, and vary widely in texture. They have been described in portions of the Springerville Ranger District as Mollic Cryoboralfs, warm, and Argic Cryoborolls, warm.[8]

Adjacent habitat types.—At higher elevations or on colder sites, the ABLA/VAMY and PIEN/BRCI HT's adjoin or form complicated mosaic patterns with the ABLA/EREX HT. Elsewhere, ecotones or mosaics occur mainly with the ABLA/RUPA HT and habitat types containing *Picea pungens* as a climax or coclimax tree. If slope contrasts are strong, then warm south-facing slopes opposite stands of the ABLA/EREX HT may have *Abies concolor* as a major component of the mixed conifer forest.

Discussion.—This habitat type is the *Abies lasiocarpa/Erigeron superbus* habitat type (ABLA/ERSU HT) of Moir and Ludwig (1979). The ABLA/EREX HT presents a variety of productive silvicultural opportunities for timber management for *Picea engelmannii* and *Pseudotsuga menziesii*. The diverse and luxuriant undergrowth, combined with thermal protection by the dense overstory, make this an important wildlife habitat for many game and nongame species.

Surface fires probably played the major role in creating mosaics of *Populus tremuloides* and *Pseudotsuga menziesii*, but very little is known about fire succession in this environment (Fischer and Clayton 1983). *Pseudotsuga menziesii* may be maintained in the overstory by periodic ground fires which would selectively remove the more susceptible *Abies* and *Picea* saplings, leaving *P. menziesii*, and providing a good seedbed for *P. menziesii* regeneration. At higher elevations, *P. menziesii* does not occur in some stands, perhaps because such stands are more nearly climax; or disturbance by fire may be less effective in initiating its regeneration at the colder limits of the habitat type. Alternatively, the somewhat colder environment at higher elevations may simply exceed the reproductive tolerance of *P. menziesii*.

In contrast, *Populus tremuloides* is an important tree throughout the ABLA/EREX HT. Dense *P. tremuloides* clones are often short-lived, and are replaced by conifers within a century. However, occasional tall trees can persist in the overstory canopy of conifer-dominated stands that are between 200 and 300 years old. *Populus tremuloides* sprouting may be stimulated by logging and burning practices that open the canopy and warm the soil (Jones and DeByle 1985, Schier et al. 1985).

Figure 10.—*Abies lasiocarpa/Erigeron eximius* habitat type, typic phase. This type, common between 9,400 and 10,200 feet (2,860 and 3,100 m) in the study area, provides opportunities for timber and wildlife management. A forb cover of 10% to 75% or more exceeds cover of the less prominent graminoids and shrubs.

Abies lasiocarpa/Rubus parviflorus habitat type (ABLA/RUPA; subalpine fir/western thimbleberry)

We found the ALBA/RUPA HT (fig. 11) in the Mogollon Mountains, Gila National Forest, Glenwood and Wilderness Ranger Districts.

Vegetation.—*Abies lasiocarpa* is present, usually in all sizes, and always with 40 to 520 stems less than 4.5 feet tall per acre (99 to 1,285 per ha). *Picea engelmannii* usually is subordinate. In some stands, *Pseudotsuga menziesii* dominates, exhibiting abundant regeneration in successional *Populus tremuloides* stands; there is less regeneration in more mature stands.

Both tall and low shrub layers are present, with cover ranging from 15–55% in our plots. *Acer glabrum* and

Figure 11.—*Abies lasiocarpa/Rubus parviflorus* habitat type. Whitewater Canyon, Mogollon Mountains, 8,140 feet (2,481 m) elevation. A diverse and luxuriant undergrowth, with thermal protection provided by a dense overstory, make this habitat type a preferred wildlife summer habitat.

Rubus parviflorus always were present, each with coverage ranging from a trace to 20%. Other shrubs present in at least half our plots were *Holodiscus dumosus*, *Lonicera utahensis*, *Ribes pinetorum*, and *Robinia neomexicana*. *Vaccinium myrtillus* had less than 1% cover, and usually was absent.

Herbaceous cover varies from 1% to 35%, with many species present in trace amounts. We always found *Bromus ciliatus*, *Geranium richardsonii*, *Goodyera oblongifolia*, and *Ramischia secunda* in the plots. The following plants often were present: *Artemisia franserioides*, *Clematis pseudoalpina*, *Disporum trachycarpum*, *Epilobium angustifolium*, *Osmorhiza depauperata*, *Pteridium aquilinum*, *Senecio cardamine*, *Smilacina racemosa*, *Viola canadensis*, and *Zygadenus elegans*.

Physical setting.—The ABLA/RUPA HT occurs on moist, protected sites between 8,140 and 9,640 feet (2,481 and 2,938 m) elevation on northwest and northeast aspects. It is found at streamsides, in draws, and on middle and lower slopes with gradients that vary between 20% and 60%. Soils have not been studied in detail, but often appear as cobbly or very cobbly phases of Cryoboralfs and Cryoborolls at the warm extreme of the cryic soil temperature regime. They appear more productive than soils found in many other *Abies lasiocarpa* or *Picea engelmannii* habitat types.

Adjacent habitat types.—Adjoining colder or wetter sites may support forests of the ABLA/EREX HT or the ABLA/VAMY HT, RUPA phase. Less moist sites support ABCO/QUGA, ABCO/ACGL, or ABCO/Sparse HT's.

Discussion.—The ABLA/RUPA HT was first described by Moir and Ludwig (1979). It is closely related to the ABLA/VAMY HT, RUPA phase and the ABLA/EREX HT. The varied undergrowth composition, which provides browse and forage, and the diverse structure of the stand—composed of an herbaceous layer, two shrub layers, and various sizes of trees—make this type excellent habitat for numerous wildlife species.

Picea pungens Series

Picea pungens/Senecio cardamine habitat type (PIPU/SECA; blue spruce/cardamine groundsel)

We found the PIPU/SECA HT (fig. 12) in the White and Blue Mountains, Apache National Forest, along the East Fork of Thomas Creek and along Hannagan Creek.

Vegetation.—*Abies concolor* and *Pseudotsuga menziesii* were overstory dominants in our stands, with *Picea pungens* important, especially as regeneration. *Pinus strobiformis*, *Picea engelmannii*, *Abies lasiocarpa*, and *Populus tremuloides* were present in some plots, with only *Picea engelmannii* and *Populus tremuloides* occurring as mature trees.

A luxuriant ground cover of forbs, including *Senecio cardamine*, and the low cover of shrubs (less than 5%) helps to identify the PIPU/SECA HT. The low shrubs, *Pachistima myrsinites* and *Rubus parviflorus*, usually were present, and 11 other shrub species sometimes were found.

Figure 12.—*Picea pungens/Senecio cardamine* habitat type. This type, found on East Fork, Thomas Creek, and Hannagan Creek, Apache National Forest, 8,600 to 8,800 feet (2,620 to 2,680 m) elevation, has a luxuriant forb layer, with shrubs poorly represented. *Senecio cardamine* predominates in photograph; other species are *Carex foena*, *Fragaria americana*, and *Geranium richardsonii*.

Grass cover varied from 1% to 27% of the area, with *Bromus ciliatus* and *Carex foenea* dominant. Those two species plus *Carex rossii*, *Koeleria nitida*, and *Poa fendleriana* are characteristic species of the habitat type. *Festuca arizonica*, *F. sororia*, and *Muhlenbergia montana* were absent from our plots.

Forbs were dominant in the herbaceous layer. Depending on the sample plot, *Thermopsis pinetorum*, *Senecio cardamine*, or *Fragaria americana* exhibited the greatest coverage. Forb coverage ranged from 24% to 61%, with *Senecio cardamine* always present. Other species often found included: *Fragaria americana*, *F. ovalis*, *Geranium richardsonii*, *Lathyrus arizonicus*, *Pteridium aquilinum*, *Senecio wootonii*, *Viola canadensis*, *Pedicularis grayi*, and *Ramischia secunda*.

Physical setting.—Our plots were found from 8,640 to 8,800 feet (2,633 to 2,682 m) elevation on northerly aspects and steep slopes (between 48% and 54%). They were on upper, middle, and lower positions of the slope.

Adjacent habitat types.—The PIPU/SECA HT lies between mixed conifer and *Picea engelmannii-Abies lasiocarpa* habitat types, and adjoins types in the *Abies concolor*, *Abies lasiocarpa*, and *Picea engelmannii* series.

Discussion.—We have subdivided the *Picea pungens-Picea engelmannii/Senecio cardamine* habitat type of Moir and Ludwig (1979) into the PIPU/SECA and PIEN/SECA HT's, with some of their plots assigned to other types, based on our more intensive sampling in the Gila

and Apache National Forests, which comprise the center of distribution for *Senecio cardamine*. This habitat type is restricted to the areas described above. It has minor importance because of the small total area it covers, but may be locally important for visual quality, timber, livestock, and wildlife as noted in Moir and Ludwig (1979).

Picea pungens/Erigeron eximius habitat type (PIPU/EREX; blue spruce/forest fleabane)

Our plots were in the Mogollon and Mimbres Mountains, in the Gila and Cibola National Forests. They were found in the Glenwood, Mimbres, Reserve, Wilderness, and Magdalena Ranger Districts, but the type probably occurs throughout the study area on suitable sites.

Vegetation.—*Pseudotsuga menziesii* and *Picea pungens* are the major climax trees, both with abundant regeneration in mature stands. *Abies concolor* is a minor climax tree, when present, which usually regenerates less abundantly than *Picea pungens* or *Pseudotsuga menziesii*. Seral trees are *Pinus ponderosa*, *Pinus strobiformis*, and *Populus tremuloides*.

The undergrowth in the PIPU/EREX HT is characteristically herbaceous and dominated by forbs (fig. 13). In some stands, graminoids also are conspicuous, but shrubs usually are minor.

Shrub cover was less than 10% in most plots, but may be as high as 44%. The most dominant shrubs were *Quercus gambelii*, *Acer glabrum*, and *Lonicera arizonica*. Those which occurred most consistently on different plots were: *Quercus gambelii*, *Rosa* spp., and *Rubus parviflorus*.

Graminoid coverage ranged between 3% and 51%, but most plots contained from 10% to 25%. Graminoids that were dominant on different plots included *Bromus ciliatus* (the only grass found on all the plots), *Poa fendleriana*, *Festuca arizonica*, *Koeleria nitida*, *Muhlenbergia montana*, and *Carex foenea*. In addition, other sedges often were found on the plots.

Figure 13.—*Picea pungens/Erigeron eximius* habitat type. This forb-rich type is found from 7,600 to 9,050 feet (2,316 to 2,758 m) throughout the study area in canyon bottoms and on moist side slopes. It is important for wildlife and esthetics.

Forbs covered 18–97% of the area in the plots, but a 20–70% range included most of the plots. Forbs covered about 1.4 to 27 times more area than graminoids on any one plot. Sixteen species expressed dominance over a number of different plots, but *Achillea millefolium* occurred with the highest frequency. Characteristic species are *Artemisia franserioides*, *Fragaria* spp., *Erigeron eximius*, *Campanula rotundifolia*, *Cystopteris fragilis*, *Dugaldia hoopesii*, and *Pseudocymopteris montanus*. *Rudbeckia laciniata*, a forb found on wet sites, was absent from our plots, although *Prunella vulgaris* and *Actaea rubra*, also typical of wet sites, were sometimes found.

Physical setting.—Lower sites from 7,820 to 8,450 feet (2,383 to 2,575 m) tend to lack *Erigeron eximius* and are typified by *Fragaria* spp. and *Achillea millefolium*. Such plots were found on all aspects on lower slopes with subsurface water flow and on streamside locations one meter or more above the summer water level. In contrast, plots with *Erigeron eximius* were found between 8,040 and 9,050 feet (2,450 and 2,758 m) on sideslopes and benches on northerly aspects, except above 9,000 feet (2,743 m), where they were found on southeastern aspects. They apparently depended less on subsurface water, although most of those plots also were in lower slope or canyon bottom sites.

Adjacent habitat types.—Drier upslope sites may support the ABCO/QUGA, PSME/MUVI, and PSME/QUGA HT's. When the PIPU/EREX HT is on north slopes, stands representing ABCO/Sparse and ABLA/EREX HT's may be found upslope. On south slopes, the ABCO/MUVI, PIPO/MUVI, PIPO/QUGR, and PIPO/FEAR HT's were found adjacent to the PIPU/EREX HT. The PIPU/CAFO HT can be interspersed with the PIPU/EREX HT. In moister sites, the PIPU/POPR HT occurs. When the PIPU/EREX HT is on a slope with a northerly aspect, lower sites may support the ABLA/EREX HT. The PIPU/EREX HT often occurs as a stringer in canyon bottoms with drier, warmer types on either side. Types from different series often adjoin the PIPU/EREX HT at its upper and lower edges.

Discussion.—These herb-rich *Picea pungens* forests have a variable undergrowth composition, but always are characterized by forb dominance. Moir and Ludwig (1979) described a *Picea pungens-Picea engelmannii/Erigeron superbus* habitat type, which we have subdivided, separating the PIEN/EREX and PIPU/EREX HT's because of the overstory difference. We added to those plots representing the PIPU/EREX HT several herb-rich plots which lacked *Erigeron eximius*. DeVelice et al. (1986) also described the PIPU/EREX HT as we have. Alexander et al. (1984a) described a *Picea pungens/Fragaria ovalis* habitat type, named in conjunction with a preliminary classification, including a PIPU/FROV HT, presented in an earlier manuscript of this paper. Their PIPU/FROV HT may be equivalent to our PIPU/EREX HT, but there are some differences, notably in shrub coverage and species.

This habitat type, while restricted in area, is commercially and esthetically important. It is intrinsically resilient, but is subject to abuse because it is easily ac-

cessible to people and animals. Its occurrence in canyon bottom stands and its luxuriant herbaceous cover situated between less luxuriant types on steep hillsides create a travel lane for wild animals, livestock, and humans. Improper use of the type may adversely affect vegetation, soils, and groundwater levels. For example, overgrazing can cause a decrease in *Carex* spp., grasses, and *Erigeron eximius*, and an increase in *Achillea millefolium*, *Lathyrus arizonicus*, *Pseudocymopteris montanus*, *Prunella* spp., and *Dugaldia hoopesii*. Our plots showed intensive use by deer, elk, and squirrels.

Because of the better soil-plant moisture relationships associated with this type, timber growth is likely to be rapid, but we detected windthrow and signs of dwarf mistletoe (*Arceuthobium* spp.) infestations on *Pseudotsuga menziesii* and *Picea pungens*.

Picea pungens/Carex foenea habitat type (PIPU/CAFO; blue spruce/silvertop sedge)

We found this type in the White Mountains and Blue Mountains of Arizona, on the Springerville and Alpine Ranger Districts of the Apache National Forest. It probably occurs elsewhere in the study area, as is evident from the widespread presence in other parts of Arizona and New Mexico (Moir and Ludwig 1979, Alexander et al. 1986, DeVelice et al. 1986).

Vegetation.—*Picea pungens* and *Pseudotsuga menziesii* usually are climax codominants, both with at least light or moderate regeneration (fig. 14). *Pinus ponderosa*, *Pinus strobiformis*, and *Populus tremuloides* are conspicuous seral trees. *Abies concolor* usually is absent. Colder sites may have small amounts of *Picea engelmannii*, with regeneration less abundant than that of *Picea pungens* and *Pseudotsuga menziesii* combined.

Figure 14.—*Picea pungens/Carex foenea* habitat type. This habitat type is found on ridges and slopes between 7,840 and 9,400 feet (2,389 and 2,865 m) elevation. The strongly herbaceous undergrowth is dominated by sedges. It is a scenic type and is productive for timber and forage.

Shrubs usually were minor in this type. The normal range of cover was 0–4%, and no single species was consistently present. *Juniperus communis*, *Rubus parviflorus*, and *Rubus strigosus* were common.

The ground vegetation layer is strongly herbaceous, with graminoids providing the greatest visual impression, although their actual coverage may be less than that of forbs. Rhizomatous sedges may have greater coverage than bunchgrasses.

The graminoid component was diverse, and *Carex foenea* was the most characteristic species. Other graminoids frequently found were *Carex rossii*, *Festuca arizonica*, *Koeleria nitida*, and *Muhlenbergia virescens*. Notably absent was *Poa pratensis*. Graminoid cover ranged from 8% to 23%.

Forbs were unusually diverse and important components, having between 1% and 31% cover, but none were consistently present nor dominant. Some characteristic ones were *Campanula rotundifolia*, *Erigeron eximius*, *Fragaria ovalis*, *Haplopappus parryi*, *Pseudocymopteris montanus*, *Senecio neomexicanus*, *Senecio wootonii*, *Townsendia formosa*, and *Viola canadensis*.

Physical setting.—Sampled stands ranged from 7,840 to 9,400 feet (2,389 to 2,865 m) elevation, from ridges to lower slopes mostly paralleling drainages. Slope gradients varied from 0% to 50%, mostly on southwest aspects, except at lower elevations where the type was found on northerly aspects. Soils do not appear to be phreatic, at least within the upper horizons. Rather, it has been suggested that cold air drainage is important for most of the *Picea pungens* habitat types, including the PIPU/CAFO HT (Layser and Schubert 1979). The soil temperature regime is generally interpreted as being at the cold edge of the frigid zone.

Adjacent habitat types.—Grassy parklands may border this habitat type. Adjoining forests may include the ABLA/EREX, ABCO/ACGL, ABCO/FEAR, PIPO/FEAR, and PIPU/POPR HT's.

Discussion.—Moir and Ludwig (1979) described a PIPU/CAFO HT. We used their plots and ours to provide better resolution, reclassifying some of their PIPU/CAFO HT plots into a separate PIPU/FEAR HT. The PIPU/CAFO and PIPU/FEAR HT's described here would be equivalent to the *Pseudotsuga menziesii* phase, PIPU/CAFO HT, of Moir and Ludwig (1979). DeVelice et al. (1986) and Alexander et al. (1986) also described a PIPU/CAFO HT similar to ours.

Forb dominance in this habitat type may be natural in some stands, but graminoids have a significant amount of cover and impart a visual impression of dominance. Forb dominance also may be induced by grazing. The strong forb component shows the relationship of the PIPU/CAFO HT with the PIPU/EREX HT. In instances where forb dominance is slight and the graminoid component is strong, site factors may be important in distinguishing between these two habitat types.

Two *Picea pungens* stands were found with strong shrub components, but species composition in the sampled plots was such that we could not assign the stands to either the PIPU/COST HT (Alexander et al. 1986) or the PIPO/FROV HT (Alexander et al. 1984a). Instead, we classified those stands as a PIPU/CAFO HT and a PIPU/EREX HT based on herbaceous dominance.

The PIPO/CAFO HT is very productive for timber and forage and is esthetically attractive because of tree species diversity and association with meadows.

Picea pungens/Festuca arizonica habitat type (PIPU/FEAR; blue spruce/Arizona fescue)

We found the PIPU/FEAR HT in the Mogollon and White Mountains, Gila and Apache National Forests; specifically the Springerville, Alpine, Reserve, and Wilderness Ranger Districts.

Vegetation.—*Picea pungens* and *Pseudotsuga menziesii* are climax trees in this type (fig. 15). *Pinus ponderosa* is late seral, but often is codominant with the climax trees in stands that are several hundred years old. *Abies concolor* usually is absent, but when present, its regeneration is less than that of *Picea pungens*. *Populus tremuloides* is absent, or is found only locally in small, short-lived clones.

Figure 15.—*Picea pungens/Festuca arizonica* habitat type. Upper Negrito Creek, Mogollon Mountains, 7,560 feet (2,304 m) elevation. This habitat type is dominated by *Picea pungens*, *Pseudotsuga menziesii*, and a luxuriant grass undergrowth; it occupies unique and unusual sites.

Shrubs are unimportant, although sometimes present. Shrub coverage in our plots was less than 5%.

Undergrowths are dominated by assorted bunchgrasses, but rhizomatous sedges often are present. Grass cover varies from 3% to 68%. *Festuca arizonica* or *Muhlenbergia virescens* usually dominate, but *Poa fendleriana* or *Bromus ciliatus* may be dominant on north slopes. The only grass found on all plots was *Koeleria nitida*. Other graminoids frequently found were *Carex foenea* and *Muhlenbergia montana*.

Forb coverage ranged from a trace to 62%, but most commonly from 6% to 35%. Many species were represented, but none were consistently found or consistently dominant. Typical forbs were *Achillea millefolium*, *Erigeron eximius*, *Fragaria ovalis*, *Haplopappus parryi*, *Penstemon barbatus*, *Senecio neomexicanus*, and *Senecio wootonii*.

Physical setting.—The PIPU/FEAR HT occurs between 7,560 and 9,120 feet (2,304 and 2,779 m) elevation on all aspects and slope steepnesses. Above 9,000 feet (2,743 m), it is found on southerly aspects and in all positions on the slope. Below 8,300 feet (2,530 m), it occurs on northerly aspects of lower slopes. Soil subgroups are highly varied and include Udic Argiborolls, Udic Haploborolls, Lithic Haploborolls, Eutric Glossoboralfs, Typic Dystochrepts and Typic Haplustolls.

Adjacent habitat types.—Drier sites support PSME/MUVI and PIPO/FEAR HT's. When the PIPU/FEAR HT occurs at lower elevations on lower slopes, the PIPO/FEAR HT may exist upslope. Ecotones exist with these types on sideslopes, and they may contain some accidental *Picea pungens* because of the proximity of a consistent seed source. The ABCO/FEAR HT also may form ecotones with the PIPU/FEAR HT. Where more moisture is available, the PIPU/CAFO or PIPU/EREX HT's are adjacent to the PIPU/FEAR HT. The PIPU/POPR HT is found in drainage bottoms below slopes that support the PIPU/FEAR HT

Discussion.—Intermediate stands between the PIPU/FEAR and PIPU/EREX HT's were found in our study, and plots in these situations with low total herbaceous cover were retained in the PIPU/FEAR HT, regardless of dominance by forbs. Because the PIPU/FEAR HT occurs on slopes, it is not as subject to overuse by livestock as are some other *Picea pungens* habitat types. It is productive, and provides good forage for cattle and elk, while abundant forbs make it desirable for deer and sheep. As tree stands mature, *Festuca arizonica* and *Muhlenbergia montana* decrease, but remain in openings. The PIPU/FEAR and PIPO/FEAR HT's merge gradually in ecotone areas which support a mixture of both types, especially on east exposures. These grassy blue spruce stands can be very scenic, having high esthetic and recreational values. Little bare ground occurs in the PIPU/FEAR HT under natural conditions. The combined moss plus litter cover in our plots varied from 75% to 95%. The soil probably absorbs precipitation readily, resulting in an erosion-resistant watershed.

The PIPU/FEAR HT also was described by DeVelice et al. (1986) in northern New Mexico.

Picea pungens/Poa pratensis habitat type (PIPU/POPR; blue spruce/Kentucky bluegrass)

This type, widespread throughout New Mexico (Moir and Ludwig 1979), was found at only one site in the present study (fig. 16). The sole location was on Little Turkey Creek in the Mogollon Mountains, in the Wilderness Ranger District, Gila National Forest.

Vegetation.—The basic characteristics of this type are the presence of *Picea pungens* and an extremely rich herbaceous layer in a streamside location. The general appearance of the association is grassy, with significant forb cover. *Poa pratensis* is always present. In our plot, *Picea pungens* was dominant, with *Pinus strobiformis* and *Pseudotsuga menziesii* present. Shrub, graminoid, and forb cover was 8%, 112%, and 46%, respectively. The importance of shrubs probably varies with the nature of the streamside; our plot included *Salix bebbiana, Rosa* spp., *Alnus* spp., and *Potentilla fruticosa*.

Physical setting.—The plot occurred at 8,000 feet (2,438 m) elevation, at the lower end of the range that extended up to 9,100 feet (2,774 m) in the study by Moir and Ludwig (1979). This type occurs only on alluvial soils adjacent to perennial streams.

Adjacent habitat types.—Adjacent types include PIPU/FEAR and PSME/MUVI HT's. Tree cover is often sparse in this type.

Figure 16.—*Picea pungens/Poa pratensis* habitat type. This habitat type is uncommon but widespread throughout the southwest between 8,000 and 9,100 feet (2,438 and 2,774 m) elevation. It is attractive for commercial and recreational activities. Undisturbed stands can rarely be found because of intensive use in the past.

Figure 17.—*Abies concolor/Erigeron eximius* habitat type. Apache Kid-Cowboy area of the San Mateo Mountains, 9,500 feet (2,895 m) elevation. A luxuriant undergrowth, including *Bromus ciliatus*, is found under the *Abies concolor* and *Pseudotsuga menziesii* overstory. Tree site quality is moderate to good.

Discussion.—This streamside *Picea pungens* habitat is closely related to the PIPU/COST HT (Alexander et al. 1986). Many palatable browse and herbaceous species occur in the PIPU/POPR HT. The type is susceptible to overuse by livestock because of the palatable plants and its topographic location on flat land adjacent to water. It also is a highly esthetic type, with other amenities such as fishing; it often is used for campgrounds. The type probably is naturally resilient, but use frequently exceeds its ability to recover from disturbance. Very few good examples of this type exist, and those remaining can be lost to soil erosion and lowered water tables unless protected.

Abies concolor Series

Abies concolor/Erigeron eximius habitat type (ABCO/EREX; white fir/forest fleabane)

This habitat type was found in the Black Range, San Mateo, Mimbres, and Mogollon Mountains in the Gila and Cibola National Forests.

Vegetation.—*Abies concolor* and *Pseudotsuga menziesii* form a canopy over a luxuriant undergrowth of *Bromus ciliatus*, which is characteristic of this type (fig. 17). There is a dramatic decrease in *Abies concolor* between the 0–2 and 2–10 inch d.b.h. classes (0–5.1 and 5.1–25.4 cm); there are 130 to 8,400 stems per acre (321 to 20,756 per ha) in the smaller class and 10 to 230 per acre (25 to 568 per ha) in the larger size class, respectively. *Pinus strobiformis* is prominent in late seral stands. *Pinus ponderosa* is occasionally present, sometimes with moderate regeneration which does not survive competition with *Abies concolor* and *Pseudotsuga menziesii*. *Abies lasiocarpa* is absent or accidental, and *Picea engelmannii*, if present, is represented by less than 25 stems per acre in the 2- to 10-inch (5.1–25.4-cm) size class.

Although coverage of shrubs (mostly *Acer glabrum*) may be 0% to 60%, it is less than that of grasses or forbs. Grasses, dominated by *Bromus ciliatus*, cover 6% to 95%.

Forbs cover 8% to 124%, including such species as *Achillea millefolium*, *Artemisia franserioides*, *Erigeron eximius*, *Fragaria ovalis*, *Haplopappus parryi*, *Lathyrus arizonicus*, *Pteridium aquilinum*, *Pyrola chlorantha*, *Senecio bigelovii*, *Smilacina stellata*, and *Viola canadensis*. Plants notable by their absence include *Berberis repens*, *Juniperus communis*, *Vaccinium myrtillus*, and *Festuca arizonica*. On some sites, total grass cover exceeds 80% and is dominant over forbs. *Trisetum montanum* and *Festuca sororia* have more than 1% coverage. On other sites, *Festuca sororia* and *Trisetum montanum* are absent, with grass cover less than 40%. Forbs approach or exceed grass coverage. Within this latter group, our plots in the Mimbres Mountains differ from the typical expression of the type by having only 17% to 34% herbaceous coverage, with *Erigeron eximius* absent and *Bromus ciliatus* and *Agropyron arizonicum* sharing dominance.

Physical setting.—Most plots were on deep soils and gentle slopes. Light ground fires occurred with a 30-year frequency. *Festuca sororia* was present on upper slopes (3%–50% gradients), ridgetops, and northerly aspects from 9,560 to 9,640 feet (2,913 to 2,938 m) elevation. When *Festuca sororia* was absent, plots were in gentle mesic draws and ravines and on slopes varying from 10% to 25% with northerly aspects (one exception). Elevations of plots ranged from 8,720 to 9,600 feet (2,657 to 2,926 m).

Adjacent habitat types.—Moister sites on warmer, shallow soil support the ABCO/QUGA HT. Drier sites support the PSME/BRCI HT and the *Muhlenbergia virescens* phase of the ABCO/QUGA HT. Higher elevations support ABCO/MUVI stands.

Discussion.—Moir and Ludwig (1979) originally described this type as the *Abies concolor-Pseudotsuga menziesii/Erigeron superbus* habitat type. We shortened the name and used *Erigeron eximius* to conform with presently accepted taxonomy (appendix B).

Populus tremuloides and *Robinia neomexicana* dominate seral stands. Care may be required during logging and prescribed burning to prevent excessive increases in shrub density. *Pseudotsuga menziesii* was heavily infested with dwarf mistletoe (*Arceuthobium* spp.), and some insect defoliation was noticed in our plots. Site quality for trees is moderate to good for both *Pseudotsuga menziesii* and *Abies concolor*.

Abies concolor/Sparse habitat type (ABCO/Sparse; white fir/sparse)

The ABCO/Sparse HT is very common throughout the study area and elsewhere (Moir and Ludwig 1979) (fig. 18).

Vegetation.—This type is characterized by *Abies concolor* and *Pseudotsuga menziesii* dominance; however, *Abies concolor* may be absent in the overstory. A prominent shrub layer of *Robinia neomexicana*, *Quercus gambelii*, *Symphoricarpos oreophilus*, *Sambucus* spp., and *Lonicera* spp. is present, but none are constant. The herbaceous layer may be composed of numerous species,

Figure 18.—*Abies concolor*/Sparse habitat type. Crest Trail, Mimbres Mountains, 9,160 feet (2,791 m) elevation. This habitat type has an obvious tall shrub layer, with mosses and lichens dominating herbs.

but it usually provides less than 2% total ground cover (occasionally as much as 10%). Mosses and lichens may be important on microsites free of tree litter. The following shrubs were not found in our plots: *Acer grandidentatum*, *Cornus stolonifera*, *Jamesia americana*, and *Juniperus communis*. Openings in the ABCO/Sparse HT may have either a depauperate herbaceous layer with increased grasses, or a somewhat greater cover of forbs dominated by such species as *Pteridium aquilinum*, *Senecio wootoni*, *Hieracium fendleri*, and *Senecio neomexicanus*.

Physical setting.—Our plots were found from ridges to midslope (4–65% gradient) on all aspects between 8,550 and 9,480 feet (2,606 and 2,889 m) elevation.

Adjacent habitat types.—Moist drainage bottoms adjacent to stands of the ABCO/Sparse HT support *Abies concolor*, with extensive *Berberis repens* in the undergrowth. Some of these stands are in the ABCO/ACGL HT, and may lack *Berberis repens*. Drier sites support the ABCO/MUVI HT and both phases of the ABCO/QUGA HT. Dry ridges support the PSME/MUVI HT, with increased *Holodiscus dumosus* and *Robinia neomexicana* on rocky areas. Mossy patches may occur on shallow soils. The ABCO/Sparse HT can grade into grassy types in younger stands on drier sites.

Discussion.—The ABCO/Sparse HT was first described as the ABCO-PSME HT (sparse understory) by Moir and Ludwig (1979). Subsequently, the present name was applied by Alexander et al. (1984a) and DeVelice et al. (1986). The ABCO/Sparse HT resembles the ABCO/BERE and ABCO/SYOR HT's. (Youngblood and Mauk 1985), but there are some important differences.

Stands of *Abies concolor*, varying from 80 to 100 years old, that were reestablished following fire in the ABCO/Sparse HT, exhibited an undergrowth similar to the climax. Such stands also were characterized by fallen pole-sized stems of *Populus tremuloides*, which exhibited advanced root rot in 30-year old stands. An older *Populus tremuloides* clone in this type contained a similar undergrowth, with increased *Berberis repens*, *Bromus* spp., *Smilacina* spp., *Pterospora andromeda*, *Corallorhiza* spp.,

Fragaria ovalis, *Symphoricarpos oreophilus*, and *Robinia neomexicana*. Infection by dwarf mistletoe (*Arceuthobium* spp.) was less on *Pseudotsuga menziesii* than on other species in this type. Some windthrow was evident. In the Mogollon Mountains, between 8,700 and 9,200 feet (2,652 and 2,804 m) on upper northerly slopes, the PIEN/VAMY HT was found in draws below the ABCO/Sparse HT. In this situation, *Picea engelmannii* and *Abies lasiocarpa* reproduction was found in ABCO/Sparse stands, but such reproduction may not survive to become a component of the overstory. Similar areas may be devoid of these species because of a lack of seed source.

Abies concolor/Holodiscus dumosus (Scree) habitat type (ABCO/HODU (Scree); white fir/bush rockspirea (scree))

We found the ABCO/HODU (Scree) HT in the Magdalena and San Mateo Mountains of the Cibola National Forest, New Mexico.

Vegetation.—Mature *Pinus strobiformis* and *Abies concolor* are less abundant than *Pseudotsuga menziesii*, but sometimes codominant with it. *Picea pungens*, *Picea engelmanni*, *Abies lasiocarpa*, *Juniperus* spp., and riparian trees are absent. Shrubs and graminoids are approximately equal in coverage (each with 1–25%), with trace amounts of numerous forb species. *Jamesia americana*, *Bromus ciliatus*, *Koeleria nitida*, *Allium cernuum*, and *Primula ellisiae* were always present in our plots. Other species included *Holodiscus dumosus* and *Festuca arizonica*.

Physical setting.—Our plots were located on midslopes with 50–60% gradients and northwest aspects, between 9,200 and 9,240 feet (2,804 and 2,816 m) elevation. The sites were typical of loose rock (scree) slopes (fig. 19), in that soil-water storage capacity and subsequent moisture availability for plants was low, except for deep-rooted species. Our plot data showed 13% to 30% exposed rock and 2% to 4% exposed soil as a thin layer over cobble scree.

Adjacent habitat types.—Almost any of the other mixed conifer types expected at this elevation could be found adjacent to the ABCO/HODU (Scree) HT, depending on nearby site conditions.

Discussion.—The ABCO/HODU (Scree) HT was described in northern New Mexico by DeVelice et al. (1986).

Canopy cover in this habitat type is low and timber production is poor. Dwarf mistletoe (*Arceuthobium* spp.) infestation is heavy on *Pseudotsuga menziesii* and *Pinus strobiformis*. Evidence of ground disturbance following use in this type is slight. This type is similar to other forest scree habitat types in enhancing groundwater recharge and providing special wildlife microhabitats.

Abies concolor/Acer glabrum habitat type (ABCO/ACGL; white fir/Rocky Mountain maple)

The ABCO/ACGL HT is widespread throughout Arizona and New Mexico (Moir and Ludwig 1979), including the present study area (fig. 20). It was found in all three National Forests in the White, Mogollon, San Mateo, and Tularosa Mountains, wherever elevation was sufficient.

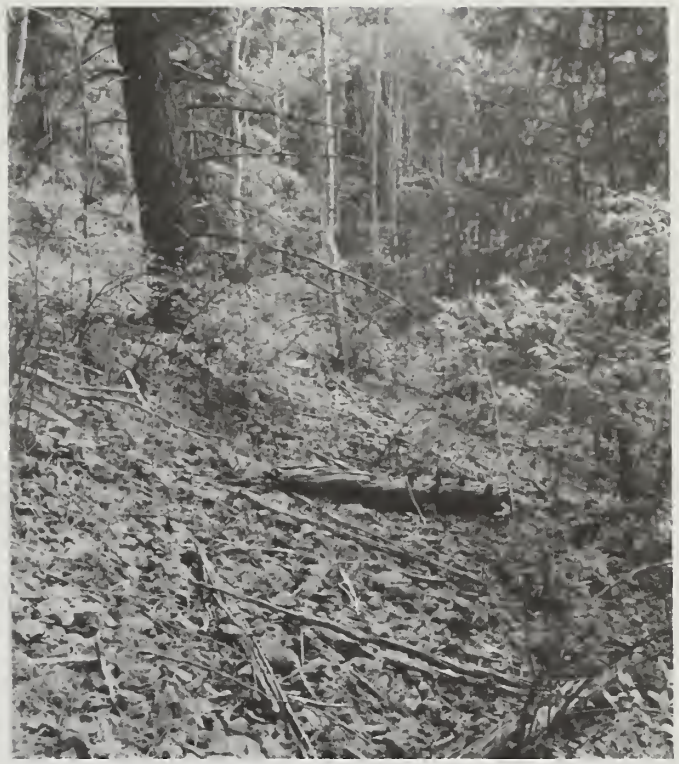

Figure 19.—*Abies concolor/Holodiscus dumosus* (Scree) habitat type. Upper San Mateo Canyon, San Mateo Mountains, 9,360 feet (2,852 m) elevation. As in all high elevation scree sites, deep-rooted shrubs dominate the undergrowth, and groundwater recharge is an important function of the type.

Figure 20.—*Abies concolor/Acer glabrum* habitat type. Windy Point, Mogollon Mountains, 8,640 feet (2,633 m) elevation. This habitat type, with its obvious tall shrub layer, is common at moderately high elevations throughout the Southwest.

Vegetation.—*Abies concolor* and *Pseudotsuga menziesii* are dominant, with *Pinus strobiformis* occasionally codominant. *Picea pungens*, *Picea engelmannii*, and *Abies lasiocarpa* are present only in small sizes or in transitional areas. Mature *Pinus ponderosa* usually is absent, but it may dominate when originated by fire; more typically it persists as scattered individuals. *Abies con-*

color and *Pseudotsuga menziesii* seedlings are very abundant; 2 inch (5 cm) and larger stems much less so. Shrub cover, including *Acer glabrum*, exceeds that of herbaceous plants except in a few plots transitional to *Picea pungens* stands. Grasses and forbs each cover less than 40% of the ground. *Acer grandidentatum*, *Cornus stolonifera*, *Juniperus communis*, *Festuca arizonica*, *Muhlenbergia montana*, *Poa pratensis*, *Festuca sororia*, *Dugaldia hoopesii*, *Ligusticum porteri*, *Mertensia franciscana*, *Pteridium aquilinum*, and *Swertia radiata* are notably absent. Moir and Ludwig (1979) described this type as the ABCO-PSME/ACGL HT, which included plots that contained *Acer grandidentatum*. We separated those plots into a different type (ABCO/ACGR HT), and shortened the name of the original type to the ABCO/ACGL HT. Moir and Ludwig (1979) also classified one plot in the White Mountains as the *Berberis repens* phase of their ABCO-PSME/ACGL HT, but we found no other representative of that phase. *Jamesia americana* occurs on cobbly substrates, while *Muhlenbergia virescens* and *Pteridium aquilinum* dominate openings, which also contain more *Bromus* spp., *Symphoricarpos oreophilus*, and *Holodiscus dumosus*.

Physical setting.—Our plots occurred from streamside settings to upper slopes which generally faced north and exhibited gradients varying from 18% to 67%. Southerly slopes supported this type only at higher elevations or streamside settings. Typical elevations were between 8,100 and 9,800 feet (2,468 and 2,987 m).

Adjacent habitat types.—Moister sites support stands characterized by the ABLA/RUPA HT. Drier south-facing slopes support PSME/HODU (Scree) and ABCO/QUGA HT's. Adjacent higher elevations support PSME/QUGA, ABLA/RUPA, and ABCO/QUGA HT's. Lower slopes support *Picea pungens-Pseudotsuga menziesii* stands.

Discussion.—In addition to Moir and Ludwig (1979), this type was identified by Alexander et al. (1984a, 1986), Youngblood and Mauk (1985) and DeVelice et al. (1986). Although these descriptions represent the same habitat type, there may be a geographic gradient in plant species that warrants different phase designations in some areas.

Some spruce budworm activity was noted on *Pseudotsuga menziesii*. Game trails and browsing illustrated the high value of this type for big game. The presence of a tall shrub layer increases vertical diversity for birds, and a greater number of bird species might be expected here than in less diverse types.

Abies concolor/Muhlenbergia virescens habitat type (ABCO/MUVI; white fir/screwleaf muhly)

Our plots were in the White and Mogollon Mountains and the Black Range in the Apache and Gila National Forests.

Vegetation.—*Pseudotsuga menziesii* and *Abies concolor* dominate, although *Abies concolor* sometimes is poorly represented in the overstory (fig. 21). Old individuals of *Pinus ponderosa* are present, usually with sparse reproduction. Although minor or absent in the overstory,

Figure 21.—*Abies concolor/Muhlenbergia virescens* habitat type. This type—found in the White and Mogollon Mountains and the Black Range—is dominated by *Pseudotsuga menziesii* and *Abies concolor*, with both forbs and grasses important in the undergrowth. It is found on ridges and side slopes from 8,000 to 9,700 feet (2,438 to 2,804 m) elevation.

Pinus strobiformis is present in the understory. *Picea pungens* may be accidental in small size classes. *Picea engelmannii*, *Abies lasiocarpa*, *Juniperus* spp., and riparian trees are absent. Shrubs have less than 5% coverage, and except for *Quercus gambelii* are minor components of the stand. *Muhlenbergia virescens* (more than 1% coverage) dominates grasses, with *Poa fendleriana* also present. In heavily shaded microsites, *Bromus ciliatus* may dominate. Grasses are important in the herbaceous layer, but forbs also are prominent. Occasionally, a single forb species such as *Lathyrus arizonicus*, *Pteridium aquilinum*, or *Senecio wootoni* may dominate the site. The following important indicators are absent from this type: *Acer glabrum*, *Acer grandidentatum*, *Berberis repens*, *Holodiscus dumosus*, *Jamesia americana*, *Quercus rugosa*, *Festuca arizonica*, *Trisetum montanum*, *Festuca sororia*, *Erigeron eximius*, *Ligusticum porteri*, *Mertensia franciscana*, *Senecio cardamine*, *Swertia radiata*, and *Valeriana capitata*. Where the overstory creates heavy shade, *Muhlenbergia virescens* may be reduced to presence value only. Some openings have increased amounts of *Muhlenbergia virescens*, but in openings where grass densities are reduced, patches of *Lupinus* spp. occur.

Physical setting.—The ABCO/MUVI HT typically is found on ridges down to midslopes, with 9–55% gradients and southerly aspects; but it may occur on all aspects. The typical elevational range is 8,000–9,200 feet (2,438–2,804 m).

Adjacent habitat types.—Moister sites support herb-rich *Picea pungens-Pseudotsuga menziesii* stands. Dry upper slopes support the PIPO/MUVI HT, with abundant *Pteridium aquilinum*. Higher elevations support phases of the ABCO/QUGA HT, while lower slopes support the PSME/MUVI HT and habitat types associated with *Picea pungens-Picea engelmannii* stands.

Discussion.—*Populus tremuloides* may be restricted to deeper, finer-textured soils in some stands of this type. In other stands, patches of *Quercus gambelii* were present, but *Populus tremuloides* was not. Spruce budworm

defoliation was noted on *Abies concolor* and *Pseudotsuga menziesii* regeneration in some stands. This type has been extensively logged and grazed in some areas. Plants that increase after logging are *Muhlenbergia virescens*, *Pteridium aquilinum*, and *Robinia neomexicana*.

Abies concolor/Quercus gambelii habitat type (ABCO/QUGA; white fir/Gambel oak)

The ABCO/QUGA HT is widely distributed throughout the study area (fig. 22), and also is found throughout Arizona and New Mexico (Moir and Ludwig 1979).

Vegetation.—Both *Abies concolor* and *Pseudotsuga menziesii* are climax dominants, with *Pinus strobiformis* a major late seral component; all are represented in the reproduction size-class. *Pinus ponderosa* often dominated stands in our plots, and occasionally *Pinus strobiformis* was dominant. *Pinus ponderosa* reproduction may sometimes reach 120 stems per acre (296 per ha), but does not persist as older age classes in mature stands. The undergrowth is dominated by *Quercus gambelii*, or at least *Quercus gambelii* is well represented, with more than 5% cover in a tall shrub or small tree layer. *Robinia neomexicana* is more dense on cobble-scree and rocky areas. *Festuca arizonica*, *F. sororia*, and *Trisetum montanum* are absent. The typic (*Quercus gambelii*) phase has less than 4% *Muhlenbergia virescens* coverage, whereas the *M. virescens* phase has considerably more. The *Muhlenbergia virescens* phase of this habitat type is distinguished from the ABCO/MUVI HT by a 5% or more cover of *Quercus gambelii*.

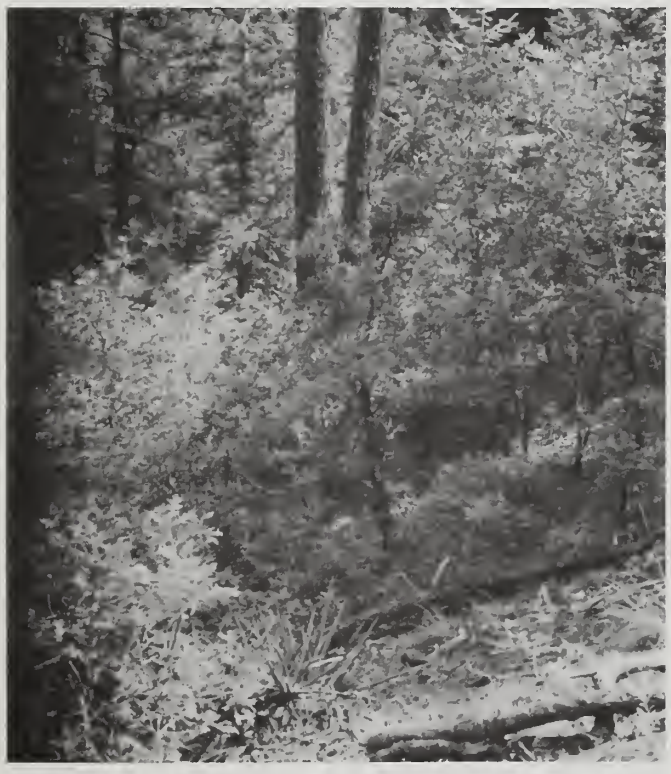

Figure 22.—*Abies concolor/Quercus gambelii* habitat type, typic phase. Apache Kid Trail, San Mateo Mountains, 8,200 feet (2,499 m) elevation. Site quality for timber often is poor in this habitat type, with potential brush and grass competition hindering tree regeneration following disturbance.

Physical setting.—Our plots were mostly on ridges and side slopes, but some occurred on lower slopes at lower elevations. Elevations varied from 7,400 to 9,560 feet (2,255 to 2,913 m) and slope gradients from 40% to 77%. This type occurs on steep slopes, with soils varying from thin and rocky to deep and loamy. Aspects supporting the *Quercus gambelii* phase were northern or southeastern, except that at higher elevations some stands occurred on southwestern exposures. The *Muhlenbergia virescens* phase was found more on southern aspects, except at lower elevations. However, on shallow soils, plots were found on northern slopes throughout the elevational range of the phase.

Adjacent habitat types.—Ecotones with ABCO/QUGA and PSME/QUHY HT's are typical. Moister sites supported the ABCO/Sparse and ABCO/ACGL HT's. Drier sites supported PSME/MUVI and PIPO/MUVI HT's. Lower canyon-bottom sites supported the PIPU/FROV HT. Rocky ridges with skeletal soils and other dry edaphic sites supported the PSME/QUHY HT, while steep west-facing upper slopes supported ABCO/Sparse stands.

At elevations where the ABCO/QUGA HT occurs on north-facing slopes, several habitat types may be encountered with changes in aspect. For example, beginning on steep southerly slopes and proceeding in a northerly direction around the slope, vegetation progresses from chaparral through pinyon-juniper to the PSME/QUGA HT (with *Pinus ponderosa* dominant in seral stands), continuing into the PSME/MUVI HT (with sparse forbs), and finally into the ABCO/QUGA HT.

Discussion.—The ABCO/QUGA HT was identified by Moir and Ludwig (1979), Alexander et al. (1984a, 1986), Youngblood and Mauk (1985), and DeVelice, et al. (1986).

Succession following fire or other disturbance usually results in increased densities of *Quercus gambelii*, *Robinia neomexicana*, *Lonicera* spp., and possibly *Muhlenbergia virescens*. Herbaceous cover may be reduced to 5% as the canopy closes. Timber site quality in the *Quercus gambelii* phase often was poor, with short and round-topped trees. Band-tailed pigeons (*Columba fasciata*) were nesting in this type.

Abies concolor/Robinia neomexicana habitat type (ABCO/RONE; white fir/New Mexico locust)

The ABCO/RONE HT was described by Moir and Ludwig (1979) from two somewhat disturbed stands in the Apache National Forest, Arizona. We located no additional sites.

Vegetation.—*Abies concolor* and *Pseudotsuga menziesii* are characteristic trees, with poor *Pseudotsuga menziesii* regeneration and abundant *Abies concolor* regeneration (about 300 stems per acre or 741 per ha). The high coverage of *Robinia neomexicana* is characteristic of the type (fig. 23). Also present in the plots were *Picea engelmannii*, *Pinus strobiformis*, *Populus tremuloides*, and *Pinus ponderosa*. Shrubs dominate the undergrowth with

45–75% cover. Forbs are subordinate to codominant with grasses in the herbaceous layer.

Physical setting.—This type occurs on volcanic ash or cinder soils, on gentle slopes at about 8,700 feet (2,652 m).

Adjacent habitat types.—This type was found on small knolls adjacent to other mixed conifer types such as the ABCO/QUGA HT.

Discussion.—The ABCO/RONE HT may be a fire-derived or logging-stimulated seral community. However, certain soil characteristics also may determine a strong dominance of *Robinia neomexicana*. Caution should be exercised in this habitat type because fire or logging activities will increase coverage of *Robinia neomexicana*, which will probably decrease tree regeneration.

Abies concolor/Festuca arizonica habitat type (ABCO/FEAR; white fir/Arizona fescue)

This type was found in the White and Mogollon Mountains, Apache and Gila National Forests and the Magdalena Mountains, Cibola National Forest (fig. 24).

Vegetation.—*Abies concolor* and *Pseudotsuga menziesii* are codominant, with regeneration varying from more than 100 stems per acre (266 per ha) for *Abies concolor* and *Pseudotsuga menziesii* combined; to as much as 1,340 stems (3,330 per ha) for *Abies concolor* alone. *Pinus ponderosa* is codominant in late seral stands. *Picea pungens, Picea engelmanni*, and *Abies lasiocarpa* are absent or accidental.

Figure 23.—*Abies concolor/Robinia neomexicana* habitat type. Thickets of *Robinia neomexicana* and young *Pinus ponderosa* characterize openings on this site underlain by volcanic ash.

Figure 24.—*Abies concolor/Festuca arizonica* habitat type, typic phase. South Baldy Trail, Magdalena Mountains, 9,300 feet (2,834 m) elevation. A mixed conifer overstory and grass-dominated undergrowth make this habitat type important for cattle grazing and wild turkey nesting.

Based on coverage, shrubs and forbs were subordinate to codominant with grasses. In the *Festuca arizonica* phase, *Festuca arizonica* was the dominant herbaceous plant, with *Carex foenea, Bromus ciliatus, Muhlenbergia montana*, and *Sitanion hystrix* also present. *Berberis repens* was dominant under conifers on stony soils, but *Festuca arizonica* and *Muhlenbergia montana* dominated openings.

In the *Poa fendleriana* phase, the herbaceous layer was dominated by *Poa fendleriana*. *Robinia neomexicana* and *Bromus ciliatus* often were present, and *Festuca arizonica* was notably absent. This phase was earlier described by Moir and Ludwig (1979) as the ABCO-PSME/POFE HT.

Physical setting.—Moir and Ludwig (1979) found the type on ridges and gentle slopes or on moderate to steep east-, south-, or west-facing canyon slopes. They described the elevational range as 7,000 to 9,400 feet (2,134 to 2,865 m). Our plots in the *Festuca arizonica* phase were at 8,850 to 9,480 feet (2,697 to 2,889 m). The *Poa fendleriana* phase was found from 8,300 to 8,850 feet (2,529 to 2,697 m).

Adjacent habitat types.—Lower slopes may support habitat types having *Senecio cardamine* as the undergrowth indicator. Adjacent types included PIPU/CAFO, PIPU/FEAR, PIPU/EREX, and PSME/MUVI HT's.

Discussion.—Reasons for the absence of *Festuca arizonica* in the *Poa fendleriana* phase are unknown. It may be natural, or could be the result of overgrazing during early settlement. We did not feel justified in describing a distinct habitat type from the three plots in the *Poa fendleriana* phase.

We found abundant elk sign in the typical phase, perhaps because of greater graminoid cover and the preference of the animals for such forage. The type also is well adapted for grazing by livestock. It may be important as a brood area for wild turkeys (*Meleagris gallopavo*), because of the inherent capability of the tall grass to produce insects for young poults. In the *Poa fendleriana* phase, dwarf mistletoe (*Arceuthobium* spp.) was heavy on some tree species. Some windthrow was observed, and in one stand many trees were broken at the base.

Abies concolor/Acer grandidentatum habitat type (ABCO/ACGR; white fir/bigtooth maple)

We had only one plot in this type, which varied somewhat from the ABCO/ACGR HT of cool canyon bottoms described by Moir and Ludwig (1979). Alexander et al. (1984a) described the type in the Lincoln National Forest. Suitable sites for this type are infrequent, but the type probably occurs throughout the study area where such sites exist (fig. 25).

Vegetation.—In our plot, *Pseudotsuga menziesii* was better represented than in the Arizona plots sampled by Moir and Ludwig (1979). *Abies concolor* dominated the stand, with *Pseudotsuga menziesii* and large *Acer negundo* important components. *Picea engelmannii* and *Abies lasiocarpa* were absent. *Acer grandidentatum* with diameters greater than 2 inches (5.1 cm) numbered 280 per acre (692 per ha). *Symphoricarpos oreophilus* also was present. Grasses dominated forbs. *Poa fendleriana*, *Bromus ciliatus*, *Fragaria americana*, and *Viola canadensis* were present.

Figure 25.—*Abies concolor/Acer grandidentatum* habitat type. Upper Little Dry Creek, Mogollon Mountains, 7,360 feet (2,243 m) elevation. This infrequently occurring riparian habitat type has an extremely high value as a fish and wildlife habitat; it also serves as a fire barrier.

Physical setting.—Our plot was typical of the site described by Moir and Ludwig (1979). It was on a subirrigated cobble alluvium, 6.5 feet (2 m) above the bed of an intermittent stream in a steep-sided, shady canyon, oriented southwest. The gradient of the plot was 7%. The elevation was 7,360 feet (2,243 m).

Adjacent habitat types.—This type usually is adjacent to the ABCO/QUGA HT. It is related to the ABCO/ACGL HT, and may adjoin it on some sites. Steep topography may result in the PSME/QUGA or even the PIPO/QUGA HT's occurring adjacent to the ABCO/ACGR HT.

Discussion.—We found abundant reproduction of young conifers in mature stands in this type, but subsequent survival was low. The importance of this riparian type for wildlife and fish habitat and as a fire barrier probably is much greater than its importance as a timber and grazing resource, particularly considering the small areas involved. The following excerpts from Moir and Ludwig (1979) describe the influence of logging in the ABCO/ACGR HT. "Logging probably accelerates growth and development of *Acer grandidentatum* as a result of increased light in the understory." Furthermore, "...strong dominance of the species in logged areas does not appear to retard conifer establishment."

Abies concolor/Juglans major habitat type (ABCO/JUMA; white fir/Arizona walnut)

We found this type by Mineral Creek, Mogollon Mountains, in the Glenwood Ranger District, Gila National Forest (fig. 26). The habitat type probably occurs on suitable sites on western slopes of the Mogollon Mountains and perhaps in other ranges as well. Alexander et al. (1984a) described the ABCO/JUMA HT in the Lincoln National Forest.

Vegetation.—Large *Acer negundo*, *Juglans major*, and *Quercus gambelii* trees dominate the stand, with *Abies concolor*, *Pinus ponderosa*, and *Pseudotsuga menziesii* scattered. *Abies concolor* saplings may be abundant. The undergrowth probably is variable, but plants typical of moist but not wet sites, such as *Fraxinus* spp., *Ptelia* spp., *Toxicodendron rydbergii*, and *Vitis* spp., were present in our plot. The herbaceous layer included *Bromus ciliatus*, *Monarda menthaefolia*, *Pseudostellaria jamesiana*, and *Viola canadensis*.

Physical setting.—The single plot in this type was at 6,440 feet (1,962 m) elevation, with a southeast aspect. It was on a steep slope, 16 to 23 feet (4.8 to 7.0 m) above a permanent stream, but in a canyon-bottom environment. Soils were a cobbly-bouldery canyon detritus. Tree roots probably obtained yearlong moisture from the water table, but herbaceous plants likely were subjected to early summer drought. The site is occasionally flooded, but is above the normal flood level and the physical impact of flooding is limited.

Adjacent habitat types.—This type occurred above the adjacent riparian *Populus angustifolia* series, with chaparral and pinyon-juniper vegetation in higher positions on canyon sides.

Discussion.—While this type was represented by only one plot, it was sufficiently distinct to be classified as a separate riparian type, which was supported by another study (Alexander et al. 1984a).

Coniferous stocking was low, although young regeneration was abundant. Consequently, logging may pose problems because of the difficulty of regenerating the stand. Grasses are important to turkey and quail communities because they supply food and cover, and provide a substrate for insects, which are necessary for survival of young birds. Spring grazing may be detrimental to wildlife populations because of its effect on cover and insect populations when the young are vulnerable. Grasses also provide cover for rodents, which are an important unit in the predatory food chain. Deciduous trees in riparian areas are important to game and nongame animals because they moderate the microclimate and provide suitable conditions for a more luxuriant plant community than that found on adjacent sites.

Pseudotsuga menziesii Series

Pseudotsuga menziesii/Arctostaphylos uva-ursi habitat type (PSME/ARUV; Douglas-fir/bearberry)

We found this type only in the San Mateo Mountains, Cibola National Forest (fig. 27).

Figure 26.—*Abies concolor/Juglans major* habitat type. Lower Mineral Creek, Mogollon Mountains, 6,440 feet (1,962 m) elevation. This habitat type is dominated by riparian hardwoods, with the undergrowth typical of upland sites.

Figure 27.—*Pseudotsuga menziesii/Arctostaphylos uva-ursi* habitat type. San Mateo Canyon, San Mateo Mountains, 8,800 feet (2,644 m) elevation. An extensive undergrowth of *Arctostaphylos uva-ursi* and low timber production potential characterize this type.

Vegetation.—Both *Pseudotsuga menziesii* and *Pinus strobiformis* are important, and *Arctostaphylos uva-ursi* has extensive coverage (more than 30% in our plots). Other shrubs, including species with tall form, were less important. *Bromus ciliatus* also was present.

Physical setting.—Our plots were on ridgetops between 9,800 and 9,900 feet (2,987 and 3,017 m).

Adjacent habitat types.—Warm, dry, lower slopes adjacent to the PSME/ARUV HT support the ABCO/FEAR HT, POFE phase and related habitat types.

Discussion.—Our plots lacked *Abies concolor*, but we observed a stand that contained *Abies concolor*, dense *Arctostaphylos uva-ursi*, *Bromus ciliatus*, *Achillea millefolium*, *Erigeron eximius*, and *Geranium richardsonii*, and was located on deep alluvium adjoining an intermittent creek at 8,800 feet (2,682 m) elevation. DeVelice et al. (1986) described a *Pinus flexilis/Arctostaphylos uva-ursi* habitat type, with less undergrowth coverage than in our plots; but otherwise similar to them. The occurrence of *Arctostaphylos uva-ursi* in the undergrowth of these various habitat types suggests some relationship in about their classification. Consequently, additional sampling is needed to clarify their status.

Fires have been extensive and severe in this type, resulting in *Populus tremuloides* becoming established as a major seral tree. Timber site quality apparently is low; trees are about 30 feet (9.1 m) tall with rounded or dead tops.

Pseudotsuga menziesii/Holodiscus dumosus (Scree) habitat type (PSME/HODU (Scree); Douglas-fir/bush rockspirea (scree))

We sampled this type only on Black Mountain in the Mogollon Mountains, Glenwood Ranger District, Gila National Forest (fig. 28). The habitat type probably is found on high elevation scree slopes in other mountain ranges as well.

Vegetation.—*Pseudotsuga menziesii* is dominant. *Pinus strobiformis* and *Populus tremuloides* also may be present. Shrubs dominate herbaceous plants, with 17–23% coverage. Forbs have 6% or less coverage, and dominate grasses, which have 1% or less. Typical plants are *Holodiscus dumosus, Salix scouleriana, Symphoricarpos oreophilus, Bromus ciliatus, Clematis pseudoalpina, Haplopappus parryi,* and *Smilacina stellata.*

Physical setting.—Our plot, on loose rock, was on a steep (57%) southerly slope at 9,600 feet (2,926 m) elevation. The site exhibited 80% exposed rock. The type appears to be limited to areas with loose surface rock, making water available only to deep-rooted species. Some plants may obtain water from pockets of soil perched on the unstable rocks. There was no exposed soil in our plot.

Adjacent habitat types.—Adjoining stands include various mixed conifer, *Picea engelmannii,* and *Abies lasiocarpa* habitat types, the nature of which depends on site factors that may vary considerably from the scree slopes on which the PSME/HODU (Scree) HT is found.

Discussion.—*Abies lasiocarpa* and *Picea engelmannii* may be present in this type, providing a seed source exists nearby (DeVelice et al. 1986). Ground disturbance would have little effect on aesthetics, the ecology of the site, or on germination and early establishment of tree seedlings. The sites would be difficult to log. They are important for groundwater recharge as with the ABLA/HODU (Scree) HT. Certain rodents such as Mexican woodrats (*Neotoma mexicana*), white-throated woodrats (*N. albigula*), and golden-mantled ground squirrels (*Citellus lateralis*), and reptiles including the short-horned lizard (*Phrynosoma douglassii*) and rock rattlesnake (*Crotalus lepidus*) find excellent habitat in this type. The PSME/HODU (Scree) type also was described by DeVelice et al. (1986) in northern New Mexico.

Figure 28.—*Pseudotsuga menziesii/Holodiscus dumosus* (Scree) habitat type. Black Mountain, Mogollon Mountains, 9,600 feet (2,926 m) elevation. Water is available only to deep-rooted species (shrubs and trees), except where it accumulates in soil pockets perched on unstable rock.

Figure 29.—*Pseudotsuga menziesii/Festuca arizonica* habitat type. Magdalena Mountains, 9,600 feet (2,926 m) elevation. This high elevation grassy type is dominated by *Festuca arizonica.*

Pseudotsuga menziesii/Festuca arizonica habitat type (PSME/FEAR; Douglas-fir/Arizona fescue)

This habitat type is found throughout the study area at moderate to high elevations (fig. 29). We sampled it in the Magdalena, San Mateo, and White Mountains in all three National Forests.

Vegetation.—This is another type described by Moir and Ludwig (1979). *Pseudotsuga menziesii* is usually dominant in all size classes. *Pinus strobiformis* and *Pinus ponderosa* occasionally are codominant. *Pseudotsuga menziesii* regeneration is usually moderate to abundant (20–490 stems per acre or 49–1,211 stems per ha). *Abies concolor* is not important in the stand. Shrubs (primarily *Holodiscus dumosus*) are subordinate to grasses, with less than 3% coverage. Grasses with 1% to 52% cover usually dominate the undergrowth; *Festuca arizonica* is usually the dominant grass, but *Bromus ciliatus, Muhlenbergia montana,* and other grasses often are present. *Bromus ciliatus* dominates under trees, with *Festuca arizonica, Muhlenbergia montana,* and *Poa fendleriana* in openings. *Muhlenbergia virescens* usually is absent, but may have 1% coverage in the New Mexico portion of the study area.

Physical setting.—Our plots were on ridges and upper and middle slopes from 9,250 to 10,200 feet (2,819 to 3,108 m) elevation. All aspects were represented except northeast, and slope gradients varied from 15% to 55%. This type is extensive on warm upper slopes, and is closely related to the PSME/BRCI HT.

Adjacent habitat types.—Both higher and lower elevations may support the PSME/BRCI HT. Similarly, phases of the PSME/QUGA HT also are found adjacent to this type. *Quercus gambelii* is dominant on rocky ridgetops.

Discussion.—Grass fires tend to reduce the density of conifer saplings and maintain grass cover in this type. The grazing value of this type would be high wherever slope steepness and distance to water are not limiting.

Pseudotsuga menziesii/Bromus ciliatus habitat type (PSME/BRCI; Douglas-fir/fringed brome)

The PSME/BRCI HT is found in the Magdalena, San Mateo, and Mogollon Mountains in the Cibola and Gila National Forests, New Mexico.

Vegetation.—*Pseudotsuga menziesii* dominates both the overstory and the regeneration understory (fig. 30); *Pinus strobiformis*, or the hybrid *Pinus strobiformis* x *flexilis*, may be codominant and have low to moderate regeneration in late seral stands. *Abies concolor* is unimportant and only occasionally present. A distinguishing feature of this habitat type is the diverse and extremely luxuriant herbaceous undergrowth dominated by grasses. Total herb cover averages about 75%, but often exceeds 100%. The only constant undergrowth species is *Bromus ciliatus*, but other dominants frequently found are *Festuca arizonica*, *Poa fendleriana*, *Carex foenea*, *Achillea millefolium*, *Erigeron eximius*, *Haplopappus parryi*, and *Thalictrum fendleri*. Shrubs may or may not be conspicuous; the principal species, when present, are *Acer glabrum* and *Ribes pinetorum*. There are many minor or subordinate species, but *Berberis repens*, *Quercus gambelii*, *Rubus parviflorus*, *Vaccinium mytillus*, and *Muhlenbergia virescens* were absent in our plots.

Figure 30.—***Pseudotsuga menziesii/Bromus ciliatus*** **habitat type. Grassy Mountain Lookout, San Mateo Mountains, 9,860 feet (3,005 m) elevation. *Pseudotsuga menziesii* dominates the overstory and the grassy undergrowth is extremely luxuriant. The type lies at the cold, wet extreme of the *Pseudotsuga menziesii* series environmental gradient.**

Physical setting.—This is basically a habitat type of deep, well-watered soils (such as Udic Haploborolls and Udic Argiborolls) on gentle upper slopes and broad ridgetops, mostly between 9,280 and 10,100 feet (2,828 and 3,078 m). We believe that the soil temperature regime is very near the cryic-frigid boundary, with the diurnal temperature range extended during the growing season because of lower nighttime temperatures caused by high reradiation or cold air convection. The more exposed sites contain trees with numerous, large limbs and heights less than about 50 feet (15.2 m), suggesting high evaporative demands and open growing conditions.

Adjacent habitat types.—*Picea engelmannii* and *Abies lasiocarpa* forests occur on slightly colder microsites; ABCO/ACGL or PSME/QUGA HT's occur on warmer microsites. Where cold air flows down gentle intermittent stream courses on cumulic soils, the ABCO/EREX HT can be encountered below the PSME/BRCI HT at an elevation as low as 8,500 feet (2,591 m). Small grassy parks with *Bromus ciliatus*, *Festuca arizonica*, and *Muhlenbergia montana* sometimes border the PSME/BRCI HT. Where rapid topographic changes occur, grassy *Pinus ponderosa* types may adjoin the PSME/BRCI HT.

Discussion.—Because of its limited area and for the reasons described below, this is not an important commercial forest. Some stands are logged because of the high volumes of old-growth *Pseudotsuga menziesii*. Mostly, this habitat type occurs in wilderness areas or on ridge crests where logging activities would have an adverse visual impact. Furthermore, growth in many stands appears only marginal. Herbaceous competition can be expected to hinder regeneration of *Pseudotsuga menziesii*, and low temperatures will most likely reduce annual growth rates. Windy sites probably have slow timber growth rates and pose severe regeneration problems. Closed, fully stocked stands may take centuries to develop under natural conditions.

There is evidence of occasional grass fires, but their frequency is unknown. On sheltered sites, such as draws, *Populus tremuloides* is an important seral species.

The PSME/BRCI HT provides ample forage for both wildlife and livestock. Heavy livestock use decreases *Festuca arizonica* and favors such species as *Achillea millefolium*, *Artemisia ludoviciana*, *Oxalis* spp., *Dugaldia hoopesii*, *Iris missouriensis*, *Pteridium aquilinum*, and *Poa pratensis*. The type is a known nesting area for band-tailed pigeons. We observed evidence of browsing activity by deer and rabbit on *Pseudotsuga menziesii* seedlings

in our plots, probably adversely affecting regeneration growth and survival. Also, we observed sites in this habitat type where grass fires killed saplings in thickets, possibly creating gaps in the age-class distribution of trees.

This habitat type is closely related to several other mixed conifer types with well-expressed herbaceous undergrowths. It resembles the ABCO/ACGL HT except for the much more luxuriant herbaceous undergrowth and poor representation of *Abies* as a climax species. Finally, the PSME/BRCI HT somewhat resembles ridgetop and windy site *Pinus flexilis* and *P. aristata* stands of northern New Mexico and Colorado (Marr 1961). However, the deep, mollic soils of the PSME/BRCI HT contrast sharply with the drier, more shallow, more stony, and often entisolic soils of these northern pine habitat types. Because of these various differences compared with related habitat types, we have concluded that the PSME/BRCI HT is a distinctive type at the cold and wet extreme of the *Pseudotsuga menziesii* series.

Pseudotsuga menziesii/Quercus gambelii habitat type (PSME/QUGA; Douglas-fir/Gambel oak)

Both the typic and *Muhlenbergia virescens* phases of this habitat type are widely distributed throughout the entire study area (fig. 31). The *Festuca arizonica* phase is represented mostly in the Magdalena District of the Cibola National Forest, but it may be more widespread.

Vegetation.—*Pseudotsuga menziesii* or *Pinus ponderosa* is dominant. *Pseudotsuga menziesii* reproduction is more abundant in the typic phase, but sometimes not in other phases. *Abies concolor* is absent or unimportant in the stand. Shrubs, including *Quercus gambelii*, are equal to or exceed grass or forb coverage.

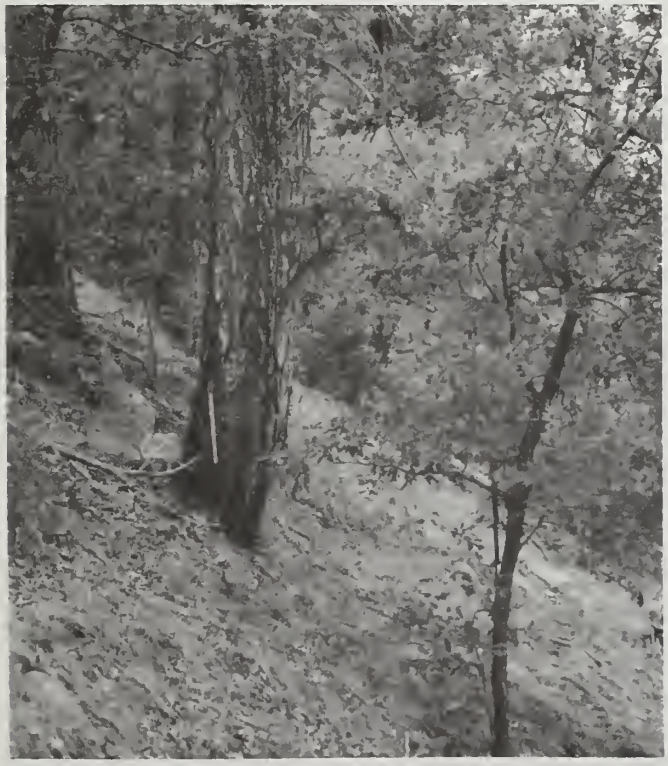

Figure 31.—*Pseudotsuga menziesii/Quercus gambelii* habitat type, typic phase; Russell Canyon, Gallo Mountains, 7,000 feet (2,133 m) elevation. This type occurs over a wide elevational range, often on thin or rocky soils, with cobbly or fractured parent materials.

In the *Festuca arizonica* phase, *Festuca arizonica* dominates the herbaceous layer. *Muhlenbergia virescens* dominates in the *Muhlenbergia virescens* phase. *Poa fendleriana* is dominant or codominant in the *Quercus gambelii* phase.

Physical setting.—The habitat type is found between 6,500 and 9,650 feet (1,981 and 2,941 m) elevation on moderate to steep slopes (19% to 81%). Sites vary from lower slopes and rocky breaks at lower elevations to upper slopes and ridgetops above 8,000 feet (2,438 m). Soils vary, but often are shallow, with cobbly texture and fractured bedrock that provide pathways for root growth.

Adjacent habitat types.—Moister sites supported *Abies concolor, Picea pungens*, and *Populus angustifolia* types, and other *Pseudotsuga menziesii* types. Drier sites included the PIPO/MUVI HT and the PIPO/QUGA HT, MULO phase. Dry, rocky areas supported the PIPO/QUGA HT.

Discussion.—The PSME/QUGA HT has been described by Alexander et al. (1984a, 1984b, 1986), Youngblood and Mauk (1985), and DeVelice et al. (1986).

Under some conditions, the PSME/QUGA HT can occur adjacent to, and on sites drier than, the PIPO/QUGR HT. In these situations, dwarf mistletoe (*Arceuthobium* spp.) infection often was severe—infections were heavy at lower elevations and lighter at higher elevations. Severe ground fires often occurred 40 to 100 years before this study and may have increased oak coverage. Sites often were poorly rated for timber growth. Although *Pseudotsuga menziesii* regenerates easily, initial survival of regeneration may be a problem.

Big game sign was abundant in this type. In the *Festuca arizonica* phase, forbs showed an affinity to the *Pinus ponderosa*-grass types of Arizona, with such species as *Artemisia ludoviciana, Arenaria lanuginosa, Bahia dissecta*, and *Commelina* spp. sometimes present. The *Festuca arizonica* phase appeared to be typical of sites which support sparse timber stands, and probably exhibit low growth potential. Distance to water and slope steepness may restrict its utility for grazing. Stands in the PSME/QUGA HT have much structural vertical diversity, and tend to support a variety of bird species.

Pseudotsuga menziesii/Muhlenbergia virescens habitat type (PSME/MUVI; Douglas-fir/screwleaf muhly)

We found the PSME/MUVI HT in the Mogollon Mountains and the Black Range, and on Elk Mountain in the Gila National Forest; it was also in the San Mateo Mountains, Cibola National Forest.

Vegetation.—Overstories in our plots were dominated by *Pinus ponderosa*, with *Pseudotsuga menziesii* or *Pinus strobiformis* often subdominant. *Pseudotsuga menziesii* regeneration was moderate to heavy (30–1,170 stems per acre or 74–2,891 stems per ha). *Abies concolor* was accidental or minor. *Picea pungens* and *Juniperus deppeana* were present in some plots, and *Populus tremuloides* oc-

casionally was a minor seral tree. Grass coverage (2–45%), with *Muhlenbergia virescens* dominant, equaled or was greater than forb coverage (trace to 12%), and exceeded shrub coverage (fig. 32). Plants that were absent included most tall shrubs and *Berberis repens*, *Quercus hypoleucoides*, *Q. rugosa*, *Symphoricarpos oreophilus*, *Vaccinium myrtillus*, *Erigeron eximius*, and *Fragaria americana*.

Physical setting.—Our plots occurred from ridgetops to lower slope positions that varied in steepness from 2% to 58% and occupied all but northeast aspects; elevations ranged between 7,880 and 9,400 feet (2,401 and 2,865 m). At lower elevations, this type was found on middle to upper slopes on northerly exposures.

Adjacent habitat types.—Moister and lower sites supported stands of *Picea pungens* and the ABCO/EREX HT. North slopes on deeper soils supported stands in the ABCO/QUGA HT. Drier sites supported the PIPO/MUVI-FEAR HT, and rocky ridgetops supported the PSME/ARUV HT. *Populus tremuloides* clones had a *Pteridium aquilinum-Muhlenbergia virescens* undergrowth, with some tall *Robinia neomexicana* plants. The PSME/QUGA HT occurred on deeper, more gravelly soils in some areas than did the PSME/MUVI HT. However, the PSME/MUVI HT also occurred occasionally on gravelly soils. It sometimes intergrades toward the PSME/QUGA HT, MUVI phase, with coverage of *Quercus gambelii* as high as 3%. It also integrades toward the ABCO/MUVI HT, but *Pseudotsuga menziesii* regeneration and grasses can exclude *Abies concolor* from the site in the PSME/MUVI HT.

Discussion.—Herbaceous cover in openings in the PSME/MUVI HT can reach 70%. More northerly slopes have more litter and less *Muhlenbergia virescens*, which is absent from tree thickets.

Some spruce budworm activity was observed on reproduction in this type.

Figure 32.—*Pseudotsuga menziesii/Muhlenbergia virescens* habitat type. Grass coverage in this type exceeds shrub coverage, and equals or exceeds forb coverage. The habitat type is found from 7,880 to 9,400 feet (2,401 to 2,865 m) elevation and on all aspects.

Figure 33.—*Pseudotsuga menziesii/Muhlenbergia montana* habitat type. San Mateo Mountains, 7,710 feet (2,350 m) elevation. This widely distributed grassy type often is dominated by *Muhlenbergia montana*, usually with other grass indicator species absent.

Pseudotsuga menziesii/Muhlenbergia montana habitat type (PSME/MUMO; Douglas-fir/mountain muhly)

The type was found throughout the study area. Most of our plots were in the San Mateo Mountains, Cibola National Forest, but the type also was sampled in the Blue Mountains, Apache National Forest, and Tularosa Mountains, Gila National Forest.

Vegetation.—Either *Pinus ponderosa* or *Pseudotsuga menziesii* may dominate a stand, but *P. menziesii* clearly is regenerating. *Pinus strobiformis*, *Pinus edulis*, *Juniperus deppeana*, and *J. scopulorum* occasionally are present, while *Abies concolor* is infrequent. Grasses, with 8–35% cover, usually dominate shrubs, and always dominate forbs (fig. 33). *Muhlenbergia virescens* usually is absent, but if not, *M. montana* dominates. Forbs are highly variable, but always sparse, with 6% or less cover. Shrubs have a trace to 10% cover. Species frequently found include *Quercus gambelii*, *Poa fendleriana*, *Artemisia carruthii*, *Erigeron platyphyllus*, *Geranium caespitosum*, and *Lithospermum multiflorum*. *Muhlenbergia rigens* and *Bouteloua gracilis* occasionally are present in small amounts. Species not found in this type include *Acer glabrum*, *Arctostaphylos uva-ursi*, *Berberis repens*, *Quercus rugosa*, *Festuca arizonica*, *F. sororia*, *Trisetum montanum*, *Erigeron eximius*, *Fragaria americana*, *Pteridium aquilinum*, and *Viola canadensis*.

Physical setting.—We found this type on all sideslope positions and in streamside settings. Slopes varied between 2% and 60%, mostly with southerly and westerly aspects. Elevations ranged from 7,540 to 9,750 feet (2,298 to 2,971 m). Some plots were on rocky, eroded, depleted soil. At lower elevations, soils were deeper and sandy.

Adjacent habitat types.—Moister sites supported the ABCO/QUGA HT. Drier sites supported the PIPO/MUMO HT. Habitat types found on adjacent ridgetops were the ABCO/ACGL, ABCO/Sparse, and PIPO/BOGR. Often, these habitat types at higher elevations were interspersed with fire-induced chaparral stands containing such species as *Cercocarpus montanus*, *Pinus edulis*, *Yucca baccata*, *Juniperus deppeana*, *Quercus grisea*, and *Muhlenbergia rigens*. Lower elevation sites supported the ABCO/MUVI and PSME/MUVI HT's. *Holodiscus dumosus* and *Quercus gambelii* increased on rocky areas, while meadows were grassy, with *Carex rossii* having about 30% coverage.

Discussion.—Grazing that occurs consistently during the same season causes successional changes in this type, the nature of which depends on the season when grazing occurs. Improper grazing can result in an undergrowth that is dominated by unpalatable forbs. Occasional, large, solitary oaks are den trees for wildlife, and are important food sources for turkey, deer, elk, bear, and songbirds. If wildlife values are to be sustained or enhanced, such trees should be maintained in the stand.

Pseudotsuga menziesii/Quercus hypoleucoides habitat type (PSME/QUHY; Douglas-fir/silverleaf oak)

The PSME/QUHY HT was sampled only in the Glenwood Ranger District of the Gila National Forest, on the south and west slopes of the Mogollon Mountains (fig. 34). It also occurs south of the Mogollon Rim in Arizona and in the Black Range in New Mexico.

Vegetation.—This is a climax type of mixed *Pinus ponderosa* and *Pseudotsuga menziesii*, with shrubs strongly dominant in the undergrowth (15% to 93% coverage). Either *Quercus rugosa* or *Q. hypoleucoides* is dominant, but other shrubs often are present. Grasses and forbs have less than 10% coverage. Indicators of this type include a mixture of some of the following: *Agave* spp., *Echinocereus* spp., *Nolina microcarpa*, *Opuntia* spp., *Quercus rugosa*, *Q. hypoleucoides*, *Muhlenbergia longiligula*, and *M. monticola*. The herb layer usually is poorly represented, but occasional forbs include *Haplopappus parryi*, *Lithospermum multiflorum*, *Pseudocymopteris montanus*, and *Senecio neomexicanus*.

Figure 34.—*Pseudotsuga menziesii/Quercus hypoleucoides* habitat type. Kings Crown, Mogollon Mountains, 7,880 feet (2,401 m) elevation. At climax, a mixture of shrubs, *Pinus ponderosa*, and *Pseudotsuga menziesii* dominate this warm, dry type.

Physical setting.—This is a warm, dry type. It occurs on ridges and upper slopes from about 7,420 to 8,640 feet (2,261 to 2,633 m) and down to 6,920 feet (2,109 m) on middle and lower slopes. We found it only on southerly slopes of 37% to 85%.

Adjacent habitat types.—Adjacent types include those associated with canyon-bottom riparian sites. North and west slopes adjacent to the PSME/QUHY HT support stands of *Abies concolor* and *Abies concolor-Pseudotsuga menziesii* mixtures. South slopes support mixed chaparral-juniper woodland.

Discussion.—We considered the PSME/QUHY HT as climax vegetation because any further successional development would require changes in accumulated litter and soil organic matter content. Such changes could take centuries on these dry, erosion-prone sites. Ecologists who disregard time may prefer to identify this habitat type as a persistent seral community or a fire disclimax. Both *Pseudotsuga menziesii* and *Pinus ponderosa* are climax components. *Quercus rugosa* and *Q. hypoleucoides* are more common on rocky outcrops. There is more *Pinus ponderosa* on alluvial areas.

Dwarf mistletoe (*Arceuthobium* spp.) in this type infected *Pseudotsuga menziesii* moderately to heavily, and varied in intensity on *Pinus ponderosa*. *Pinus ponderosa* may be susceptible to fungal attacks in this type. Timber site quality is extremely poor. *Pinus ponderosa* and *Pseudotsuga menziesii* reach 45 to 55 feet (13.7 to 16.8 m) in height. Most trees over 200 years old had dead tops. Sites are steep and soils easily erodible, and as a consequence, logging could cause considerable damage. The habitat type supports little timber volume, and obtaining regeneration after logging may be a potentially severe problem. The sites are important deer habitat, and probably support large numbers of cavity-nesting birds.

Pinus ponderosa Series

Pinus ponderosa/Muhlenbergia virescens habitat type (PIPO/MUVI; ponderosa pine/screwleaf muhly)

This type occurs throughout the study area on all suitable sites (fig. 35).

Vegetation.—*Pinus ponderosa* is the dominant tree. *Abies concolor* and *Pseudotsuga menziesii* are absent or accidental—*P. menziesii* regeneration is less than 30 per acre (74 per ha). The undergrowth is dominated by *Muhlenbergia virescens*, and *Festuca arizonica* is absent.

Forbs are sparse, usually with less than 1% cover for individual species. Shrub coverage may equal that of grass.

We recognized a *Quercus gambelii* phase (more than 1% *Quercus gambelii*), which has a tendency to include tree species other than those found in the *Muhlenbergia virescens* phase. New Mexico stands tend to support more *Pinus edulis* and *Juniperus deppeana* than do stands in Arizona.

Physical setting.—The type occurred on all aspects between 7,760 and 8,700 feet (2,365 and 2,651 m). We found the type on all slope positions from alluvial benches to upper slopes.

Adjacent habitat types.—The PIPO/MUVI HT adjoins mesic *Pinus ponderosa* types in addition to stands with various combinations of *Pseudotsuga menziesii, Picea pungens,* and *Abies concolor.* Adjacent, moister sites supported PSME/QUGA, PIPU/FEAR, PSME/MUVI, and ABCO/QUGA HT's.

Discussion.—*Muhlenbergia virescens* seemed to occur on drier sites in the Gila and Cibola National Forests than in the Apache National Forest and farther west in Arizona. Repeated light surface fires were typical in this type, and evidence of a crown fire more than 150 years ago was observed on some plots. This is one of the most productive timber and forage types in the *Pinus ponderosa* series. *Poa compressa, Sitanion hystrix,* and *Iris missouriensis* increase under grazing. *Muhlenbergia virescens* was less abundant on flat alluvial sites. *Pinus ponderosa* seedlings were always present, sometimes with as many as 110 per acre (272 per ha). Turkeys, band-tailed pigeons, western tanagers (*Piranga ludoviciana*), western bluebirds (*Sialia mexicana*), and pygmy nuthatches (*Sitta pygmaea*) were observed in this type, attesting to its wildlife value. The mast and diversity provided by *Quercus gambelii* are partly responsible, and perpetuation of tree-sized oaks is important for wildlife species.

Figure 35.—*Pinus ponderosa/Muhlenbergia virescens* habitat type, *Quercus gambelii* phase. Kerr Lookout, Tularosa Mountains, 8,600 feet (2,621 m) elevation. *Muhlenbergia virescens* seems to occur on drier sites in the Gila National Forest than it does farther west and north.

Figure 36.—*Pinus ponderosa/Muhlenbergia virescens-Festuca arizonica* habitat type, typic phase. Iron Creek Mesa, Mogollon Mountains, 8,280 feet (2,523 m) elevation. This habitat type is identified by equal dominance of the two grasses for which the type is named.

Pinus ponderosa/Muhlenbergia virescens-Festuca arizonica habitat type (PIPO/MUVI-FEAR; ponderosa pine/screwleaf muhly-Arizona fescue)

This type appears to be concentrated in the White and Blue Mountains of Arizona and adjacent New Mexico areas. However, it also was found in the Gila Wilderness on Iron Creek Mesa and near Snow Lake outside the wilderness area.

Vegetation.—Stands consist of climax *Pinus ponderosa* with *Abies concolor* and *Pseudotsuga menziesii* absent or accidental. The undergrowth is characteristically grassy, with both *Muhlenbergia virescens* and *Festuca arizonica* represented (fig. 36). *Quercus gambelii* has 1% to 3% coverage (less than grasses) in the *Quercus gambelii* phase, and less coverage in the other phases. The *Bouteloua gracilis* phase is characterized by *B. gracilis* as a natural component. *Juniperus deppeana* and *Pinus edulis* also may be present. The typical phase lacks *Bouteloua gracilis,* and more *Pinus strobiformis* and *Pseudotsuga menziesii* may be present than in other phases.

Physical setting.—The PIPO/MUVI-FEAR HT occurs between 8,000 and 8,720 feet (2,438 and 2,657 m) elevation. All aspects and slopes up to 45% are represented. The typic phase usually occurs on gentle slopes along drainages, lakes, broad saddles, and flat, high-elevation mesas.

Adjacent habitat types.—This habitat type is near the wet end of the moisture gradient typical of the *Pinus ponderosa* series, but adjacent drier sites can support pinyon-juniper vegetation. Grassy mixed conifer and *Pseudotsuga menziesii* habitat types border it on north slopes and at higher elevations. Drainages on north-facing slopes may support *Picea pungens* habitat types. Although the PIPO/MUVI-FEAR HT is a separate type locally and is not a transition between the PIPO/FEAR and PIPO/MUVI HT's, from a broad geographical perspective it may be a climatically influenced transi-

tion between the PIPO/FEAR HT of northern Arizona and the PIPO/MUVI HT of southwestern New Mexico.

Discussion.—In this type, *Muhlenbergia virescens* has the greatest coverage on cobbly soils. Coverage usually is less than 1% under a well developed tree canopy. *Quercus gambelii* grows on steeper slopes, and increases upslope, whereas *Festuca arizonica* increases on lower slopes. Swales and other sites with good moisture relationships in this type are the best timber sites, but some soil scarification may be needed to prepare a seedbed for tree regeneration.

Livestock induced changes in undergrowth composition tend to confuse identification of the typic and *Bouteloua gracilis* phases because *Bouteloua gracilis* invades the typic phase as a result of grazing.

Hanks et al. (1983) described the *Bouteloua gracilis* phase as a seral stage of the PIPO/MUVI-FEAR HT and called it a community type. We added no additional plots to those sampled by Hanks et al. (1983), but better acquaintance with New Mexico plant communities as a result of this study has convinced us that this is a valid phase, and not a seral stage. However, many of the typical plants in the phase can increase greatly in density as a result of disturbance.

Pinus ponderosa/*Quercus grisea* habitat type (PIPO/QUGR; ponderosa pine/gray oak)

The PIPO/QUGR HT is widely distributed in all parts of the study area (fig. 37). The *Muhlenbergia longiligula* phase occurs in the San Francisco, Mogollon, Blue, and Saliz Mountains, and probably in other areas in the central and southwestern part of the Gila and Apache National Forests. The *Muhlenbergia montana* phase is more typical of the northeastern part of the study area in the Mogollon and San Mateo Mountains. No predominating phase has been identified as typical throughout the range of the habitat type.

Vegetation.—*Pinus ponderosa*, *P. edulis*, and *Juniperus deppeana* are co-climax species. *Pseudotsuga menziesii* may be a minor climax component, but often is absent. *Quercus grisea* and other oaks dominate the undergrowth and become trees in seral stages. Grasses form an important component in a rather sparse herbaceous community. *Muhlenbergia longiligula*, *M. virescens*, or *M. montana* usually dominate. Normally, either *Muhlenbergia montana* or *M. longiligula* will be absent; but if both are present, their relative dominance determines whether the site is in the *M. longiligula* phase or the *M. montana* phase of the habitat type. *Festuca arizonica*, *Muhlenbergia dubia*, *M. emersleyi*, *Piptochaetium fimbriatum*, and *Stipa* spp. are absent.

Physical setting.—Our plots were located on ridgetops to lower slopes varying from 15% to 59%. All aspects were represented, from southeast slopes at higher elevations to northwest at lower elevations. Elevations varied from 6,160 to 8,840 feet (1,877 to 2,694 m). Soils usually were shallow, rocky, gravelly, or cobbly.

Adjacent habitat types.—Moister sites support various *Pinus ponderosa* and *Pseudotsuga menziesii* habitat types with *Quercus gambelii*, *Festuca arizonica*, *Muhlenbergia montana* or *M. virescens* undergrowths. Riparian canyon bottoms adjacent to this type often support the PIPU/EREX HT, with a narrow band of the PIPO/QUGA HT between it and the PIPO/QUGR HT. Drier sites support pinyon-juniper with *Bouteloua gracilis* and *Cercocarpus montanus* undergrowths.

Discussion.—Sites on which the habitat type is found are poor quality for timber production. Rocky areas support increasing densities of *Cercocarpus montanus*, *Juniperus deppeana*, *Bouteloua gracilis*, *Muhlenbergia montana*, with abundant *Pinus edulis* and *Quercus grisea*. Improper grazing increases *Artemisia ludoviciana* and decreases *Muhlenbergia montana*.

Pinus ponderosa/Rockland habitat type (PIPO/Rockland; ponderosa pine/rockland)

This type was found at widely scattered locations in the Apache and Gila National Forests, but probably occurs wherever suitable rocky sites exist high in the *Pinus ponderosa* zone (fig. 38).

Figure 37.—*Pinus ponderosa*/*Quercus grisea* habitat type, *Muhlenbergia longiligula* phase. Near Blue Ranger Station, San Francisco Mountains, 8,040 feet (2,450 m). *Pinus ponderosa*, *P. edulis*, and *Juniperus* spp., accompanied by *Quercus grisea* and other oaks, form a canopy over a grassy undergrowth.

Figure 38.—*Pinus ponderosa*/Rockland habitat type. Lower Steeple Canyon, San Francisco Mountains, 6,080 feet (1,853 m) elevation. The type is extremely poor for timber production and probably would normally not be harvested.

Vegetation.—*Pinus ponderosa* and sometimes *Pseudotsuga menziesii* and *Pinus strobiformis* are widely scattered. Regeneration often is sparse. The undergrowth is variable, but sparse. Shrubs typically are stunted, with only a trace of cover, but several species may be present. *Quercus grisea* may have measurable coverage, and *Muhlenbergia montana* usually is present. Many other grasses may be present, including *Muhlenbergia virescens, Festuca arizonica, Agropyron arizonicum,* and *Bromus* spp. Typically, many forbs are present, with low coverage. Grass cover is 9% to 13%, while forb cover varies from a trace to 12%.

Physical setting.—Our plots were on mid to lower slopes with gradients of 48% to 60%, and on southerly aspects from 8,300 to 8,750 feet (2,530 to 2,666 m) elevation. They were found on bare rockland sites, with exposed rock comprising 5–90% of the surface. Soil depth to bedrock is less than 4 inches (10 cm). Exposed roots and measurements on root crowns provided evidence of erosion during the last 200 years, with approximately 8 inches (20 cm) of soil lost.

Adjacent habitat types.—The PIPO/Rockland HT adjoined *Picea pungens* streamside types below. The PIPO/MUVI-FEAR HT was found upslope on drier sites, but with deeper soils.

Discussion.—These are extremely poor sites for timber and normally would not be harvested. Regeneration of trees is difficult and many decades could pass before a new stand is established. The sites may be scenic, but appear of little value for other resources. Alexander et al. (1986) described this type in the Cibola National Forest.

Pinus ponderosa/Festuca arizonica habitat type (PIPO/FEAR; ponderosa pine/Arizona fescue)

The PIPO/FEAR HT is widespread in our study area (fig. 39). We found it in most Ranger Districts, and only in the Clifton District of the Apache National Forest was the acreage minor. The habitat type occurs in almost all mountains, along the upper drainages of the Blue River, and within high valleys and plateaus. It is common in the White Mountains, and along forested slopes adjoining the San Augustin Plains.

Vegetation.—Typically, these stands are composed entirely of *Pinus ponderosa*. Occasionally, *Juniperus scopulorum* or *J. deppeana* appear. Near the drier edge of the habitat type, especially in New Mexico, *Pinus edulis* is a minor seral tree. Shrubs, if present, are sparse in the typical phase. The undergrowth is grassy (12% to 69% cover) with *Festuca arizonica* and *Muhlenbergia montana* dominant or codominant. *Stipa pringlei* may dominate also, possibly after fire.

We identified three phases in the study area. Sites with more than 5% shrub cover, including *Quercus gambelii*, are in the *Quercus gambelii* phase. The *Festuca arizonica* (typic) phase lacks *Bouteloua gracilis* and shrubs except in trace amounts. The *Bouteloua gracilis* phase contains at least 1% *Bouteloua gracilis* in the undergrowth, with shrubs less than 5%. In addition, some plots in the *Bouteloua gracilis* phase were distinguished by the presence of *Lycurus phleoides*, which is normally associated with dry sites.

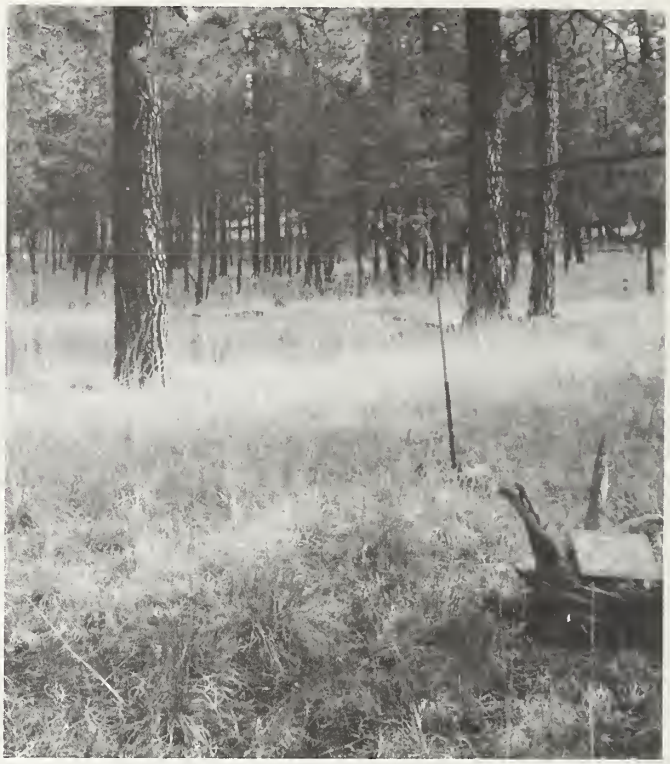

Figure 39.—*Pinus ponderosa/Festuca arizonica* habitat type, *Festuca arizonica* phase. Iron Creek Canyon, Mogollon Mountains, 8,040 feet (2,450 m) elevation. Phases of this habitat type provide valuable range, wildlife, and timber resources throughout the Southwest.

Physical setting.—The PIPO/FEAR HT is found typically on gentle slopes of all aspects between 7,880 and 8,114 feet (2,401 and 2,473 m) elevation. The *Bouteloua gracilis* phase can occur at lower elevations to about 7,400 feet (2,256 m). The *Quercus gambelii* phase can be found on steeper slopes or where soils appear more stony. These phases can occur on shallow soils, but usually soils are deep or moderately deep. The soil moisture regime is toward the wet end of ustic, and soil temperatures are near the frigid zone (USDA Forest Service 1983).

Adjacent habitat types.—The PIPO/FEAR HT represents a middle range within the vegetation gradient in the *Pinus ponderosa* series. It usually is found adjacent to other *Pinus ponderosa* habitat types. However, the PSME/QUGA HT and the mixed conifer and *Pinus edulis-Juniperus* spp. types also may be adjacent where site characteristics change rapidly. Where soils are more stony, or on north-facing steeper slopes, the PIPO/QUGA HT can be found. The PIPO/FEAR HT commonly borders open grassy parks dominated at climax by *Festuca arizonica, Muhlenbergia montana,* and associated herbs. *Bouteloua gracilis* parks are found on flat areas, with fine textured alluvial soils, adjacent to the *Bouteloua gracilis* phase.

Discussion.—This is an important and major habitat type in the Southwest[9] (Hanks et al. 1983, DeVelice et al. 1986). The major changes in the present study from the description by Hanks et al. (1983) of the PIPO/FEAR HT are the increased presence of *Pinus edulis*, *Juniperus* spp., and *Lycurus phleoides* in the *Bouteloua gracilis* phase. *Juniperus* spp. and *Pinus edulis* trees seem to be found more frequently on drier sites and as one proceeds easterly through the range of the type. *Juniperus deppeana* may increase following fire or cutting. Timber productivity is mostly moderate or high, depending upon soil properties. Fires have been important historically, with surface fires recurring about every 4 to 8 years. These fires usually covered large areas, often 3,000 acres (1,214 ha) or more (Swetnam and Dieterich 1985). Herbage productivity is inversely related to tree density or overstory dominance (Clary 1975, Hall 1983). This habitat type constitutes a major range for livestock. The undergrowth is rich in cool season grasses, so that pine-bunchgrass ranges are important summer pasturage. On overused ranges, *Bouteloua gracilis* increases (as does *Poa pratensis* on wetter microsites), and *Festuca arizonica* and *Muhlenbergia montana* both decline.

In the *Bouteloua gracilis* phase, *Oxytropis lambertii* also appeared to increase following excessive grazing. Decreasers were *Festuca arizonica*, *Muhlenbergia montana*, and *Andropogon* spp. *Muhlenbergia repens* appeared to invade. *Fallugia paradoxa* and *Chrysothamnus nauseosus* were observed along a heavily grazed wash. Logging disturbance favored *Agropyron smithii*, *Bouteloua gracilis*, *Erigeron flagellaris*, *Lappula* spp., and annual *Lupinus* spp. In the *Quercus gambelii* phase, grazing increased *Achillea millefolium* and *Erigeron* spp., decreased grasses, and expanded the area of rubble pavement.

Range condition classes have been described by Arnold (1950, 1955), Talbot (1957), Smith (1967), Bostick,[10] Costello and Schwan,[11], and by the pine-bunchgrass scorecards.[12] Additional information on the reaction of phases of this habitat type to grazing are found in Hanks et al. (1983). Range management practices have been reviewed by Clary (1975) and Currie (1975).

All phases are important wildlife habitat, especially the *Quercus gambelii* phase because of its greater diversity, potential den sites, and mast production. The *Quercus gambelii* phase probably produces less forage and timber than the typic phase, and care is needed to avoid unnecessary soil disturbance.

The typical gentle slopes, accessibility, and high productivity of this habitat type are conducive to overuse.

[9]*U.S. Department of Agriculture, Forest Service. 1981. The plant associations of Region 2. 152 p. Region 2, Denver, Colo. (Mimeo.)*

[10]*Bostick, V. B. 1947. Principles for judging condition and trend of southwestern woodland ranges. 66 p. Southwestern Forest and Range Experiment Station and Region 3, U.S. Forest Service. (Mimeo.)*

[11]*Costello, David, F., and H. E. Schwan. 1946. Conditions and trends on ponderosa pine ranges in Colorado. 33 p. USDA Forest Service. (Mimeo.)*

[12]*Range Vegetation Score Card Handbook, 2209.21a, R-3. Apache National Forest Score Card 015, Pine Bunchgrass and Associated Grassland. USDA Forest Service, Southwestern Region.*

Figure 40.—*Pinus ponderosa/Muhlenbergia montana* habitat type. Middle Fork, Gila River Trail, Mogollon Mountains, 7,880 feet (2,401 m) elevation. *Pinus ponderosa*, *P. edulis*, and *Juniperus deppeana* and a grassy undergrowth, lacking indicator species other than *Muhlenbergia montana*, are characteristic of this moderately dry habitat type.

Pinus ponderosa/Muhlenbergia montana habitat type (PIPO/MUMO; ponderosa pine/mountain muhly)

The PIPO/MUMO HT is widely distributed in all three National Forests studied (fig. 40). The type appears to be best expressed in the southern Rocky Mountains (DeVelice et al. 1986), and was not recognized by Hanks et al. (1983) in Arizona, although we suggest below that it may occur there.

Vegetation.—*Pinus ponderosa*, *P. edulis*, and *Juniperus deppeana* usually form a tree stand, with grasses dominating the undergrowth. *Pseudotsuga menziesii*, *Juniperus monosperma*, *Quercus grisea*, and *Q. gambelii* sometimes are present, and shrubs may dominate grasses with as much as 25% cover. This type differs from the PIPO/BOGR HT in having more *Muhlenbergia montana* and *Quercus grisea*, with *Q. gambelii* often present. *Bouteloua gracilis* and *Sitanion hystrix* also are present. *Muhlenbergia virescens* is absent or present only with trace amounts. *Festuca arizonica*, *Muhlenbergia dubia*, *M. emersleyi*, and *Stipa* spp. are absent.

Physical setting.—Our plots occurred on ridges to lower slopes, with gradients from 4% to 37%. All aspects were represented between 7,140 and 8,200 feet (2,176 and 2,499 m) elevation.

Adjacent habitat types.—The PIPO/MUMO HT adjoins many other grassy types depending on the nature of the adjacent site. The relationship begins in the *Pinus edulis-Juniperus* spp. series, extends through several *Pinus ponderosa* and *Pseudotsuga menziesii* types, and ends with *Picea pungens* types on moister sites.

Discussion.—North slopes had more *Quercus gambelii* and less *Muhlenbergia* spp. Rock outcrops also had more *Quercus gambelii*, and fewer grasses grew where *Pinus ponderosa* litter occurred. Eroded or disturbed areas had more *Blepharoneuron tricholepis*, *Bouteloua gracilis*, *Poa fendleriana*, *Sitanion hystrix*, *Muhlenbergia minutissima*, *Artemisia carruthii*, *Erigeron* spp., and annual *Lupinus*

spp. Such areas may be the result of mechanical disturbance, improper grazing, or intense rodent burrowing activity. *Muhlenbergia rigens* may be locally dominant because of grazing disturbance. Our plots may have lost mid-grasses, such as *Stipa pringlei*, because of a long history of grazing.

Some plots that Hanks et al. (1983) placed in their PIPO/POFE community type probably belong in this type (see discussion of the PIPO/QUGA HT). A gradient appears to exist from the PIPO/BOGR HT, typic phase in northern Arizona (Hanks et al. 1983) to the PIPO/MUMO HT in this study and then north through New Mexico (Alexander et al. 1986; DeVelice et al. 1986) into Colorado and to Utah (Youngblood and Mauk, 1985). Descriptions of the PIPO/MUMO HT vary considerably between these areas and different phase designations probably should be assigned.

Pinus ponderosa/Quercus gambelii habitat type (PIPO/QUGA; ponderosa pine/Gambel oak)

This is a widespread type, occurring in all National Forests in this study, but more commonly in New Mexico than in Arizona.

Vegetation.—*Pinus ponderosa* is dominant, with *Pseudotsuga menziesii* absent or minor. *Abies concolor* is absent. *Pinus edulis* and *Juniperus* spp. may be present. *Quercus gambelii* is present with more than 5% cover, either as a shrub or tree or both (fig. 41). The herbaceous layer is grassy, dominated by *Bromus* spp., *Muhlenbergia longiligula, Poa fendleriana, Sitanion hystrix*, or *Carex* spp.

We recognized two phases; the *Quercus gambelii* (typic) phase is slightly less grassy than the *Muhlenbergia longiligula* phase. *Muhlenbergia longiligula* always is present in the *Muhlenbergia longiligula* phase, and is absent in the *Quercus gambelii* phase.

Physical setting.—This type occurs on ridges, slopes, and benches from 6,000 to 8,560 feet (1,828 to 2,609 m). The *Muhlenbergia longiligula* phase is usually below 7,000 feet (2,134 m), and the typic phase is on northerly slopes above 7,000 feet. Sometimes this type appears to occupy depauperate sites following erosion from unknown causes, possibly early historic grazing or fire, or a high natural rate of geologic erosion (north slopes of Brushy Mountains). At this stage in history, the type represents an edaphic climax on those sites. Hanks et al. (1983) also found the PIPO/POFE community type on areas where soil properties had been altered (see discussion below). Elsewhere, the type can occur on shallow soils where the site approaches rockland conditions.

Figure 41.—*Pinus ponderosa/Quercus gambelii* habitat type, typic phase. Upper West Fork, Pueblo Creek, San Francisco Mountains, 7,040 feet (2,145 m) elevation. *Pinus ponderosa, Quercus gambelii*, and a grassy-herbaceous layer identify this habitat type.

Adjacent habitat types.—Adjacent sites support types ranging from chaparral and *Pinus edulis-Juniperus* spp. woodlands through *Pinus ponderosa* types to the PSME/QUGA HT.

Discussion.—After reviewing our data, the data of Hanks et al. (1983), and results from the Lincoln, Cibola, Carson, and Santa Fe National Forests (Alexander et al. 1984a, 1986; DeVelice et al. 1986), the authors have concluded that several of the plots that Hanks et al. placed in a PIPO/POFE community type actually belong in a PIPO/QUGA HT, QUGA phase. Hanks et al. did not recognize a distinct habitat type because their study area was at the edge of the range of this type. Therefore, we propose to change the name of their PIPO/POFE community type to PIPO/QUGA HT, QUGA phase, to make it more consistent with developing information in the rest of Arizona and New Mexico. DeVelice et al. (1986) recognized this type, as did Alexander et al. (1984a, 1986), and Youngblood and Mauk (1985). Data from all of these studies indicates considerable geographical variation within the typic phase. Thus, the typic phase may not be ecologically equivalent in different geographical areas.

The PIPO/QUGA HT varies from low to moderate timber productivity, with shallow, rocky soils that often are easily damaged if mistreated. *Bouteloua gracilis, Achillea millefolium*, and *Artemisia* spp. may increase with disturbance, while *Muhlenbergia montana* may decrease. On eroding microsites, *Pinus ponderosa* seedlings were found growing in clumps of *Quercus gambelii* where litter and soil accumulated.

Pinus ponderosa/Bouteloua gracilis habitat type (PIPO/BOGR; ponderosa pine/blue grama)

The PIPO/BOGR HT, *Pinus edulis* phase of this habitat type (Hanks et al. 1983) was found throughout the Apache and Gila National Forests in lower elevation *Pinus ponderosa* forests (fig. 42). It undoubtedly also is present in the Magdalena District of the Cibola National Forest. The *Vitis arizonica* phase was found in the southern portion of the Apache National Forest in the Big Lue Mountains. The typical phase (Hanks et al. 1983) was not found in our area.

Vegetation.—*Pinus ponderosa* is the canopy dominant, but *Juniperus deppeana* and *Pinus edulis* usually are more abundant in small sizes. In many New Mexico stands, the woodland representative *Juniperus deppeana* replaces *Pinus edulis* in the Hanks et al. (1983) key and

in descriptions for the *P. edulis* phase in northern Arizona. *Quercus grisea* usually is present, but tree-form *Q. gambelii* is found only occasionally. Grasses have greater cover than shrubs. *Bouteloua gracilis* is always dominant or codominant in the undergrowth.

The *Vitis arizonica* phase is a riparian type along intermittent streams, with *Pinus ponderosa*, *Bouteloua gracilis*, and *Quercus* spp. found in combination with a low, but significant, coverage of vines and shrubs such as *Vitis arizonica*, *Lonicera albiflora*, *Prunus* spp., *Rhamnus betulaefolia*, and *Rhus glabra*. Such plants are found at this elevation only where water is augmented from off-site sources.

Physical setting.—Our plots were in all topographic positions. Slopes varied from 1% to 34%, and elevations from 5,720 to 8,040 feet (1,743 to 2,450 m). Soils included those that were shallow and rocky, and others that were deep, sandy loam alluviums with few coarse fragments. The *Vitis arizonica* phase was on deep, subirrigated soils (Typic Ustifluvents), possibly with a relatively persistent high water table.

Adjacent habitat types.—This is the driest *Pinus ponderosa* type that we identified. Drier sites support *Pinus edulis-Juniperus* spp. woodlands and *Cercocarpus montanus*, *Quercus grisea*, and grassland communities. Moister sites support the PSME/QUGA HT and nearly any of the *Pinus ponderosa* habitat types. Thinner, rockier soils support woodlands with *Cercocarpus montanus*.

Discussion.—Most of our plots in this habitat type fit the description of the PIPO/BOGR HT, PIED phase of Hanks et al. (1983), except that *Quercus grisea* was not found in northern Arizona stands. However, we attached no ecological significance to the addition of *Q. grisea*, and stands containing it were not considered to be different phases. The *Pinus edulis* phase also seems to be similar to the *Pinus ponderosa/Bouteloua gracilis* HT, *Schizachyrium scoparium* phase of DeVelice, et al. (1986).

The demarcation between this type and the PIPO/FEAR HT, BOGR phase, is arbitrary. We used site differences and changes in vegetation gradients to make the distinction.

Figure 42.—*Pinus ponderosa/Bouteloua gracilis* habitat type, *Pinus edulis* phase. Steeple Canyon, east of Blue Ranger Station, 7,240 feet (2,206 m) elevation. This is a very common habitat type at the dry end of the *Pinus ponderosa* series environmental gradient.

Bouteloua curtipendula, *Pinus edulis*, and *Juniperus* spp. increase on westerly and southerly exposures. *Quercus gambelii* also increases on middle and lower slopes with north-facing aspects. *Poa fendleriana* occurs in patches on deeper soils. Disturbance by rodents under trees stimulates the growth of shrubs and forbs such as *Ribes* spp., *Sambucus* spp., *Argemone* spp., *Artemisia carruthii*, and *Chenopodium album*. Patches of *Andropogon gerardi* and *Poa* spp. grow under clumps of *Pinus ponderosa*. *Quercus grisea* and *Muhlenbergia longiligula* disappear on deep, sandy soils in gentle draws, where the type grades into a stand more typical of the *Pinus edulis* phase.

Grazing increases *Artemisia ludoviciana*, *Asclepias* spp., *Calliandra humilis*, *Chenopodium graveolens*, *Cirsium* spp., *Dalea* spp., *Erigeron flagellaris*, *Eriogonum alatum*, *Hymenoxys* spp., *Lupinus* spp., *Potentilla crinita*, *Aristida arizonica*, *A. fendleriana*, *Bouteloua gracilis*, and *Sitanion hystrix*. Grazing decreases *Andropogon cirratus*, *Bouteloua curtipendula*, *Piptochaetium fimbriatum*, and *Setaria* spp.

Timber productivity is low in all phases. However, the *Vitis arizonica* phase is an important riparian community because it provides water, food, and cover to wildlife that inhabit adjacent types during part of their daily or seasonal routines. It also is important for livestock forage production. However, there probably is a tendency for livestock to rest in the shade provided by the canopy, eventually causing damage to the undergrowth and preventing tree regeneration.

Pinus ponderosa/Arctostaphylos pungens community type (PIPO/ARPU; ponderosa pine-pointleaf manzanita)

This community type is found on the slopes of the Mogollon Rim throughout the Apache National Forest (fig. 43). As indicated by Hanks et al. (1983), stands best exemplifying it are found somewhere in central Arizona, south of the Mogollon Rim.

Vegetation.—This community type includes *Pinus ponderosa-Arctostaphylos* spp. or *Pinus ponderosa*-mixed chaparral communities which lack the dominant brushy life form of *Quercus gambelii* characteristic of the New Mexico *Pinus ponderosa* stands with shrubby undergrowth. *Quercus gambelii* in tree form, however, can be an important component in this community type. *Q. emoryi*, *Q. arizonica*, *Q. turbinella*, and *Arctostaphylos pungens* are characteristic.

Physical setting.—Our plots occurred on ridgetops between 6,850 and 7,600 feet (2,088 and 2,316 m) elevation on northerly aspects with 20% to 65% slopes. We know from Hanks et al. (1983) that the *Pinus ponderosa-Arctostaphylos pungens* community type occurs on relatively level sites and on other aspects as well.

Adjacent habitat types.—This community type usually occurs adjacent to chaparral or *Pinus edulis-Juniperus* spp. communities. It grows on steep slopes below the Mogollon Rim, but is a fire-disclimax community on top of the Rim. It may occur adjacent to other *Pinus ponderosa* or mixed conifer types.

Figure 43.—*Pinus ponderosa-Arctostaphylos pungens* community type. Mogollon Rim area, 7,000 feet (2,130 m) elevation. This undefined group of associations reaches its characteristic development south of the Mogollon Rim where it currently is being studied.

Figure 44.—*Populus angustifolia* series. Lower Mineral Creek, Mogollon Mountains, 6,320 feet (1,926 m) elevation. This is a group of highly variable riparian habitat types that are extremely important for wildlife.

Discussion.—Hanks et al. (1983) described this type. Habitat types within this community will be described in subsequent studies.[13] General features of the community type are described in the Terrestrial Ecosystem Survey (U.S. Forest Service 1983).

Timber productivity is low. Any disturbance in communities of this subseries will increase brush coverage to the detriment of timber, wildlife, and livestock values. Properly controlled fire at appropriate frequencies may be a useful tool in management, but wildfire or indiscriminant burning can increase the brush problem.

Populus angustifolia Series

The *Populus angustifolia* series consists of riparian (streamside or floodplain) sites at lower elevations in the coniferous forests of the Southwest (fig. 44). We sampled the series in the Mogollon and San Francisco Mountains of the Gila and Apache National Forests. The series is widespread and scattered, but encompasses a relatively small total acreage. Yet, its value and level of interest to the public are high.

Vegetation.—The distinguishing characteristics of this series are the presence of riparian trees such as *Acer negundo, Alnus oblongifolia, Juglans major, Populus angustifolia*, and low-elevation gymnosperms such as *Pinus ponderosa, P. edulis, Pseudotsuga menziesii, Juniperus deppeana*, and *J. scopulorum*. While conifers may have more stems per acre than deciduous trees, the size and crown spread of the latter often create canopy dominance. Shrubs usually are subordinate to grasses and forbs. Grasses usually dominate forbs until *Pseudotsuga menziesii* begins to appear in the canopy, when forbs become more important.

Physical setting.—This series was found between 6,200 and 7,710 feet (1,889 and 2,350 m) elevation, usually between about 1.5 and 6.5 feet (0.5 and 2 m) above the permanent water level on alluvial terraces. The plant community is highly influenced by physical site factors, including the watercourse, watershed size and shape, elevation, aspect, and onsite and upstream parent material. These, in turn, influence such things as soil moisture, depth of alluvium, and periodicity and severity of flooding.

Adjacent habitat types.—The *Populus angustifolia* series exists in riparian stringers through *Pseudotsuga menziesii, Pinus ponderosa, Pinus edulis-Juniperus* spp., and chaparral communities.

Discussion.—This series is dependent on permanent water. Some potential habitat types within the series are most likely adapted to torrential floods which scarify the soil surface, creating a disclimax undergrowth community composed of annuals and rapidly-invading or deep-rooted persistent perennials with the ability to sprout from roots. Tree seedlings typical of these flood-adapted types have slender, flexible stems.

Communities change rapidly with differences in elevation. We were unable to find enough replicates of each habitat type to adequately subdivide the series.

Comments regarding grazing, logging, and wildlife values discussed in the ABCO/ACGR and ABCO/JUMA HT's, and the *Vitis arizonica* phase of the PIPO/BOGR HT, also apply to the *Populus angustifolia* series.

[13] *Plant Association Classifications (Forest Habitat Types) for the Coronado, Prescott, and Tonto National Forests. Rocky Mountain Forest and Range Experiment Station, Contract 28-K3-307 with New Mexico State University.*

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Appendix A. Keys to the Forest Series and Habitat Types on the Apache, Gila, and Cibola (Magdalena District) National Forests

The keys to identify forest series and habitat types were developed from mature, minimally disturbed forest stands, because those that are young, or severely disturbed by grazing, logging, fire, recreation or other activities are difficult to classify. Instead of attempting to identify a disturbed stand through the key, the nearest mature stand occupying a similar site should be identified, applying the habitat type so identified to the disturbed stand. Be careful to avoid edge effects and ecotones. The habitat type of moderately disturbed sites often can be identified using these keys by inferring future tree dominance from those that are successfully reproducing and by searching carefully in undisturbed microsites for undergrowth species.

This section illustrates how the keys are used by identifying a hypothetical stand, which in this example, is an *Abies lasiocarpa/Lathyrus arizonicus* habitat type. Choose a location within the stand that you judge to be occupied by the typical vegetation. At this location, proceed with the following steps:

1. Estimate and record, by species, the relative number of trees—abundant, common, or sparse—in each of three diameter (breast height) classes: under 2 inches (5.1 cm), 2 to 10 inches (5.1 to 25.4 cm), and over 10 inches (25.4 cm).

   An example of your notes, using the first letter of the category indicating relative tree number, or a dash for no entry, would appear as follows:

Species[a]	Under 2 inches	2 to 10 inches	Over 10 inches
ABLA	c	a	s
PSME	c	–	c
ABCO	–	–	c
PIST	s	s	c

[a]*Abbreviations for habitat types employ a shorthand form of scientific notation using the first two letters of the genus and species names.*

2. Estimate and record canopy coverage of dominant shrubs, graminoids, and forbs, separating shrubs into two height categories—low shrubs, under about breast height (4.5 feet or 1.37 meters), and tall shrubs which exceed that height. For example:

   Tall shrubs—
   SASC 3%
   ACGL 1%
   Low shrubs—
   HODU 4%
   SYOR 1%
   Graminoids—
   BRCI 3%
   KOCR 2%
   Forbs—
   SEWO 1%

   Also, consider the following questions. Is the undergrowth generally shrubby? Is it mostly dominated by herbs (forbs and graminoids)? Are shrubs, forbs, or graminoids about equal in cover? Which life form (shrubs, forbs, or graminoids) shows the greatest crown cover?

3. Include in the list drawn up for Step 2 the relative abudance of indicator plants shown in various keys.[14] In this example, assume that *Erigeron eximius* covers less than 1%.

   Terminology used to describe relative abundance in keys and habitat type descriptions is as follows.

   Scarce (0 to 1%), common (>1%), poorly represented (0 to 5%), well represented (>5%), and abundant (>25%) were previously defined by Steele et al. (1981). Luxuriant represents coverage >50%. Minor or unimportant signifies that the plant does not contribute much to community composition. Accidental means that the species is not normally found in similar examples of the habitat type; its presence may be the result of seeding from adjacent types, for example.

4. Refer to the keys,As indicated earlier, the hypothetical stand in this example is identified as an ABLA/LAAR HT.
5. Compare the characteristics of the stand with the written description of the habitat type that was determined from the keys.

If the stand characteristics do not satisfactorily match the habitat type description, one or more of the following procedures may help to determine the correct habitat type:

1. Walk through the stand again, carefully reassessing its characteristics, and revising your estimates of coverage or density if necessary. Be alert for indicator plants that may have been overlooked the first time through the stand. Also, consider the patchiness of the vegetation, such as small openings or pole thickets to be a normal part of the vegetational structure, adjusting your estimates of plant cover accordingly.
2. If the selection of alternatives in the key is doubtful, follow both options at questionable decision points.
3. Compare the existing stand characteristics with all aspects of the written description, not just the vegetation portion. Questions that remain after such a comparison sometimes may be resolved by referring to the plant association tables, appendix D.
4. If necessary, measure the coverage or density of all species in a sample plot of the stand. If repeated attempts fail to identify a stand after exhausting all alternative procedures, you may have to draw the conclusion that either keys or descriptions are inadequate for the existing situation, the stand is transitional along a successional or environmental gradient, or a new plant association has been found.
5. Rely on the written description and association table, rather than the keys alone, to confirm the identity of a given habitat type.

[14]*A list of indicator species for riparian sites is shown in appendix E.*

KEYS

Key A—Key to Series and Riparian Types

1. *Picea pungens* present, neither accidental nor seral ——— 2
1. *Picea pungens* absent, accidental, or seral ——— 3
   2. *Picea engelmannii* plus *Abies lasiocarpa* less than 10 inches (25.4 cm) d.b.h. more than three times as abundant as *Picea pungens* less than 10 inches d.b.h. ——— 3
   2. *Picea engelmannii* plus *Abies lasiocarpa* less than 10 inches (25.4 cm) d.b.h. less than three times as abundant as *Picea pungens* of the same size ——— KEY C
3. *Picea engelmannii* or *Abies lasiocarpa* common; combined *Picea engelmannii* and *Abies lasiocarpa* 2 to 10 inches (5.1 to 25.4 cm) d.b.h. are more numerous than *Abies concolor* 2 to 10 inches d.b.h., usually indicating *Abies concolor* is seral, or else *Senecio cardamine* present ——— KEY B
3. *Senecio cardamine* absent. *Picea engelmannii* and *Abies lasiocarpa* both absent, or if either is present, then the total number of stems 2 to 10 inches (5.1 to 25.4 cm) d.b.h. is fewer than *Abies concolor* ——— 4
   4. Obligate riparian trees or shrubs present (*Acer negundo*, *Salix* spp., *Alnus oblongifolia*, *Populus angustifolia*, *Acer grandidentatum*, *Juglans major*) ——— 7
   4. Obligate riparian trees and shrubs absent ——— 5
5. *Abies concolor* present, neither accidental nor seral[a] ——— KEY D
5. *Abies concolor* absent or accidental ——— 6
   6. *Pseudotsuga menziesii* present, not accidental[b] ——— KEY E
   6. *Pseudotsuga menziesii* absent or accidental ——— KEY F
7. *Acer grandidentatum* dominant or codominant in undergrowth ——— *Abies concolor/Acer grandidentatum* habitat type
7. *Acer grandidentatum* minor or absent ——— 8
   8. *Populus angustifolia* or *Alnus oblongifolia* present ——— *Populus angustifolia* Series
   8. *Populus angustifolia* and *Alnus oblongifolia* absent ——— 9
9. *Abies concolor*, *Juglans major* present, *Bouteloua gracilis* absent ——— *Abies concolor/Juglans major* habitat type
9. *Abies concolor* absent, *Pinus ponderosa* and *Bouteloua gracilis* present on low-elevation riparian sites ——— *Pinus ponderosa/Bouteloua gracilis* habitat type, *Vitis arizonica* phase.

Key B—*Picea engelmannii* and *Abies lasiocarpa* Series

Picea pungens absent (occasionally seral); 2 to 10 inch (5.1 to 25.4 cm) d.b.h. *Picea engelmannii* and *Abies lasiocarpa* together more numerous than 2 to 10 inch d.b.h. *Abies concolor*.

1. Herb plus low shrub cover less than 5% ——— *Picea engelmannii/Moss* habitat type
1. Herb plus low shrub cover 5% or greater ——— 2
   2. *Vaccinium myrtillus* common (at least 1% cover), often dominant ——— 3
   2. *Vaccinium myrtillus* scarce, often absent ——— 5
3. *Rubus parviflorus* common, usually more than 2% cover ——— *Abies lasiocarpa/Vaccinium myrtillis* habitat type, *Rubus parviflorus* Phase
3. *Rubus parviflorus* scarce or absent (rarely to 4% cover, but then much less common than *Vaccinium myrtillus*) 4
   4. *Abies lasiocarpa* absent or accidental. ———*Picea engelmannii/Vaccinium myrtillus* habitat type
   4. *Abies lasiocarpa* a component of the climax community ——— *Abies lasiocarpa/Vaccinium myrtillus* habitat type, typic phase
5. Scree (loose rock) soils with shrub cover exceeding herbaceous cover ——— *Abies lasiocarpa/Holodiscus dumosus* (Scree) habitat type
5. Soils otherwise or shrub cover less than herbaceous cover ——— 6
   6. *Senecio cardamine* present ——— 7
   6. *Senecio cardamine* absent ——— 9
7. *Abies lasiocarpa* minor, seral, or accidental ——— *Picea engelmannii/Senecio cardamine* habitat type, *Abies concolor* phase
7. *Abies lasiocarpa* a climax component ——— 8
   8. *Erigeron eximius* with 1% or more coverage, or *Rubus parviflorus* with more than 2% coverage ——— 9
   8. *Erigeron eximius* absent or only trace amounts present and *Rubus parviflorus* with 2% or less coverage ——— *Picea engelmannii/Senecio cardamine* habitat type, *Abies lasiocarpa* phase
9. *Abies lasiocarpa* accidental, not climax ——— *Picea engelmannii/Erigeron eximius* habitat type
9. *Abies lasiocarpa* a climax component ——— 10
   10. *Erigeron eximius* with 1% coverage, usually more ——— *Abies lasiocarpa/Erigeron eximius* habitat type.

10. *Erigeron eximius* absent or with less than 1% coverage ——— 11
11. *Rubus parviflorus* with 1% or more coverage ——— *Abies lasiocarpa/Rubus parviflorus* habitat type
11. *Rubus parviflorus* absent or with less than 1% coverage ——— *Abies lasiocarpa/Lathyrus arizonicus* habitat type

Key C—*Picea pungens* Series

Picea pungens present as a climax component, not accidental or seral. *Picea pungens* reproduction[c] usually present. If absent, see Key B.

1. *Senecio cardamine* present usually in patches ——— *Picea pungens/Senecio cardamine* habitat type
1. *Senecio cardamine* absent or minor ——— 2
2. Obligate riparian trees or shrubs (*Salix bebbiana, Alnus* spp., and others) present. *Poa pratensis* with at least 5% cover; alluvial streamside sites. ——— *Picea pungens/Poa pratensis* habitat type
2. Obligate riparian trees or shrubs absent. *Poa pratensis* minor or absent. ——— 3
3. *Picea pungens* less than 10 inches (25.4 cm) d.b.h. fewer than twice the number of *Picea engelmannii* plus *Abies lasiocarpa* in the same size class ——— KEY B
3. *Picea pungens* less than 10 inches (25.4 cm) d.b.h. more than twice as abundant as *Picea engelmannii* plus *Abies lasiocarpa* of the same size class ——— 4
4. Forbs dominant, forb coverage about 1.5 to 30 times graminoid coverage ——— *Picea pungens/Erigeron eximius* habitat type
4. Graminoids visually dominant; forb cover not more than about 1.8 times grass coverage. *Erigeron eximius* usually 1% coverage or less ——— 5
5. Bunchgrasses and caespitose sedges well represented, coverage usually exceeding that of rhizomatous sedges with single-stem growth form ——— 6
5. Rhizomatous sedges characterize the appearance of the herbaceous layer ——— *Picea pungens/Carex foenea* habitat type
6. *Abies concolor* dominates over *Picea pungens* in all size classes ——— *Abies concolor/Festuca arizonica* habitat type, *Poa fendleriana* phase
6. *Picea pungens* more abundant than *Abies concolor* ——— *Picea pungens/Festuca arizonica* habitat type

Key D—*Abies concolor* Series

Abies concolor or *Pseudotsuga menziesii* are the dominant climax overstory trees.

1. Obligate riparian plants present ——— Key A
1. Obligate riparian plants absent ——— 2
2. Cover of herbs and shrubs together less than about 8% (sometimes more if one shrub species has up to 10% cover); usually not more than two undergrowth species with cover over 2%. *Picea engelmannii* sometimes present and not accidental ——— *Abies concolor/Sparse* habitat type
2. Cover of combined herbs and low shrubs greater than about 8%, usually more than two undergrowth species have cover over 2%; *Picea engelmannii* absent or accidental ——— 3
3. Undergrowth, excluding tall shrubs, essentially herbaceous ——— 7
3. Shrub cover about equal to or greater than herb cover ——— 4
4. *Quercus gambelii* absent or poorly represented ——— 5
4. *Quercus gambelii* dominant or at least well represented. ——— *Abies concolor/Quercus gambelii* habitat type
5. *Acer glabrum* common ——— *Abies concolor/Acer glabrum* habitat type
5. *Acer glabrum* absent or scarce ——— 6
6. *Robinia neomexicana* dominant or common ——— *Abies concolor/Robinia neomexicana* habitat type
6. *Robinia neomexicana* absent or scarce ——— *Abies concolor/Holodiscus dumosus* (Scree) habitat type
7. *Bromus ciliatus* the most prominent grass; *Erigeron eximius* with at least 1% cover. Herbaceous cover luxuriant, usually near or exceeding 100%. ——— *Abies concolor/Erigeron eximius* habitat type[d]
7. Other grasses dominant; herbaceous cover less, *Erigeron eximius* absent or with 2% or less coverage – 8
8. *Muhlenbergia virescens* the dominant grass, or at least codominant with other grasses ——— *Abies concolor/Muhlenbergia virescens* habitat type
8. Other grasses dominant or codominant ——— 9
9. *Festuca arizonica* dominant or codominant ——— *Abies concolor/Festuca arizonica* habitat type
9. Other grasses dominant ——— 10
10. *Poa fendleriana* dominant or codominant ——— *Abies concolor/Festuca arizonica* habitat type *Poa fendleriana* phase
10. *Bromus ciliatus* or *Agropyron arizonicum* dominant —— *Abies concolor/Erigeron eximius* habitat type

Key E—*Pseudotsuga menziesii* Series

Pseudotsuga menziesii is the only climax dominant tree[a].

1. Herbaceous cover often luxuriant; *Bromus ciliatus* usually dominant; *Pinus ponderosa* absent or minor ——— *Pseudotsuga menziesii/Bromus ciliatus* habitat type
1. *Bromus ciliatus* less abundant than other grasses; *Pinus ponderosa* common or absent ——— 2
   2. *Quercus gambelii* with 5% or more coverage; other *Quercus* species with less than 10% coverage ——— *Pseudotsuga menziesii/Quercus gambelii* habitat type
   2. *Quercus gambelii* with less than 5% coverage or other *Quercus* species with more than 10% coverage ——— 3
3. *Arctostaphylos uva-ursi* in conspicuous mats (San Mateo Mountains) ——— *Pseudotsuga menziesii/Arctostaphylos uva-ursi* habitat type
3. *Arctostaphylos uva-ursi* absent ——— 4
   4. *Robinia neomexicana, Holodiscus dumosus, Symphoricarpos oreophilus* or other shrubs dominate on scree soils ——— *Pseudotsuga menziesii/Holodiscus dumosus* (Scree) habitat type
   4. Soils not scree; grasses or *Quercus* spp. well represented ——— 5
5. *Quercus* spp. well represented ——— 6
5. Grasses well represented, *Quercus* spp. absent or poorly represented ——— 7
   6. *Quercus hypoleucoides* present, usually common ——— *Pseudotsuga menziesii/Quercus hypoleucoides* habitat type
   6. *Quercus hypoleucoides* absent, *Quercus grisea* common ——— *Pinus ponderosa/Quercus grisea* habitat type
7. *Muhlenbergia virescens* dominant or codominant ——— *Pseudotsuga menziesii/Muhlenbergia virescens* habitat type
7. *Muhlenbergia virescens* minor or absent ——— 8
   8. *Muhlenbergia montana* or *Poa fendleriana* dominant or codominant; *Festuca arizonica* absent ——— *Pseudotsuga menziesii/Muhlenbergia montana* habitat type
   8. *Festuca arizonica* present, usually common ——— *Pseudotsuga menziesii/Festuca arizonica* habitat type

Key F—*Pinus ponderosa* Series

Abies concolor, Pseudotsuga menziesii, Picea spp., *Abies lasiocarpa* all are absent or accidental[b]; *Pinus ponderosa* is the dominant tree.

1. Undergrowth dominated by chaparral typical of lower elevations, with *Garrya wrightii* or *Quercus turbinella* present, or *Q. rugosa* dominant among shrubs ——— *Pinus ponderosa-Arctostaphylos pungens* Community Type
1. *Garrya wrightii* and *Quercus turbinella* absent and *Q. rugosa* minor ——— 2
   2. Bedrock close to surface and much of it exposed. Small amounts of many grass and forb species present, with total undergrowth coverage less than 30%. Trees few, with poor growth. ——— *Pinus ponderosa*/Rockland habitat type
   2. Soil deeper, not a typical rockland site ——— 3
3. *Muhlenbergia virescens* important in the herbaceous layer, sometimes codominant with *M. montana*. *Festuca arizonica, Bouteloua gracilis, M. longiligula* absent or accidental; *Quercus grisea*, if present, with less coverage than the dominant grass ——— *Pinus ponderosa/Muhlenbergia virescens* habitat type
3. *Festuca arizonica, Muhlenbergia longiligula*, or *Bouteloua gracilis* present, or *M. virescens* absent or a minor component of the stand, or *Quercus grisea* with greater coverage than the dominant grasses ——— 4
   4. Both *Muhlenbergia virescens* and *Festuca arizonica* present ——— *Pinus ponderosa/Muhlenbergia virescens-Festuca arizonica* habitat type
   4. *Muhlenbergia virescens* or *Festuca arizonica* or both absent ——— 5
5. *Festuca arizonica* always present; *Festuca arizonica* and *Muhlenbergia montana* usually with more than 1% coverage; *Muhlenbergia virescens* absent ——— *Pinus ponderosa/Festuca arizonica* habitat type
5. *Festuca arizonica* absent or with less than 1% coverage, or *Muhlenbergia virescens* present ——— 6
   6. *Muhlenbergia montana* with 2% or greater coverage, usually dominating grasses; *Quercus grisea* absent or subordinate to other shrubs. *Quercus gambelii* with less than 10% coverage ——— *Pinus ponderosa/Muhlenbergia montana* habitat type
   6. *Muhlenbergia montana* with less than 2% cover, subordinate to other grasses, or *Quercus grisea* dominating shrubs, or *Quercus gambelii* with more than 10% cover ——— 7

7. *Bouteloua gracilis* or *Bouteloua curtipendula* dominant or codominant among grasses. *Pinus edulis* and *Juniperus* spp. often important components of the stand. *Quercus* spp. usually with less than 5% coverage ——— *Pinus ponderosa/Bouteloua gracilis* habitat type
7. *Bouteloua gracilis* and *Bouteloua curtipendula* subordinate to other grasses; oaks usually with 5% or more coverage ——— 8
   8. *Quercus grisea* dominant among shrubs ——— *Pinus ponderosa/Quercus grisea* habitat type
   8. *Quercus gambelii* dominant among shrubs ——— *Pinus ponderosa/Quercus gambelii* habitat type

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[a]Stands that are actually in the *Pseudotsuga menziesii* series may be incorrectly keyed to the *Abies concolor* series if long, unnatural intervals between fires have resulted in invasion of *Abies concolor* in what naturally would be *Pseudotsuga menziesii* site.

[b]Stands that are actually in the *Pinus ponderosa* series may be incorrectly keyed to the *Pseudotsuga menziesii* series if long, unnatural intervals between fires have resulted in invasion of *Pseudotsuga menziesii* in what naturally would be a *Pinus ponderosa* site.

[c]Regeneration and reproduction are used synonymously to denote trees less than 4.5 feet (1.37 m) tall.

[d]Periodic fires, low winter temperatures, and/or excessive snow cover may prevent *Abies concolor* seedlings from attaining maturity.

Appendix B. A list of plants observed in relatively undisturbed forest stands on the Apache, Gila, and Cibola (Magdalena District) National Forests and the number of plots in which the species was found

We sampled 394 plots and identified 491 plant species. See the methods section, under the heading "naming the types" for procedure used to determine synonymy.

Life Form and Species	Number of Plots[1]
Trees	
Abies concolor	154
Abies lasiocarpa	84
Acer negundo	7
Alnus oblongifolia	10
Fraxinus pennsylvanica (*F. velutina*)[2]	10
Juglans major	7
Juniperus deppeana	63
Juniperus monosperma	3
Juniperus osteosperma (*J. utahensis*)	5
Juniperus scopulorum	16
Picea engelmannii	105
Picea pungens	66
Pinus discolor (*P. cembroides*)	2
Pinus edulis	81
Pinus leiophylla	2
Pinus ponderosa	249
Pinus strobiformis	201
Populus angustifolia	7
Populus tremuloides	101
Pseudotsuga menziesii	288
Quercus arizonica	2
Quercus chrysolepis (*Q. muhlenbergii*)	1
Quercus emoryi	2
Quercus gambelii	274
Quercus grisea	58
Quercus hypoleucoides	19
Shrubs	
Acer glabrum	69
Acer grandidentatum (*A. saccharum*)	5
Alnus tenuifolia	4
Amelanchier utahensis	8
Arctostaphylos pungens	2
Arctostaphylos uva-ursi	4
Baccharis thesioides	1
Berberis repens (*Mahonia repens*)	20
Calliandra humilis	15
Ceanothus fendleri	45
Cercocarpus montanus (*C. betuloides*)	35
Chimaphila umbellata	35
Chrysothamnus nauseosus	2
Cornus stolinifera (*Swida sericea*)	6
Dalea formosa	1
Dalea leporina	1
Fallugia paradoxa	1
Fendlera rupicola	8
Garrya wrightii	8
Gutierrezia sarothrae (*Xanthocephalum sarothrae*)	2
Holodiscus dumosus	58
Hymenoxys richardsonii	11
Jamesia americana	18
Juniperus communis	34
Linnaea borealis	1
Lonicera albiflora	5

Lonicera arizonica	66
Lonicera involucrata	12
Lonicera utahensis	76
Nolina microcarpa	3
Pachistima myrsinites	39
Parthenocissus vitacea (*P. inserta*)	4
Philadelphus spp.	5
Physocarpus monogynus (*P. malvaceous*)	38
Populus tremuloides	121
Potentilla fruticosa *Pentaphylloides floribunda*)	3
Prunus emarginata	9
Prunus virginiana	10
Ptelea trifoliata	5
Quercus rugosa	13
Quercus aff. turbinella	1
Quercus undulata (*Q.* gambelii x *grisea*)	0
Rhamnus betulaefolia	9
Rhus trilobata (*R. aromatica*)	12
Rhus glabra	2
Ribes spp.	29
Ribes cereum	17
Ribes montigenum	3
Ribes pinetorum	52
Ribes wolfii	20
Robina neomexicana	107
Rosa spp.	74
Rubus arizonensis (*R. woodsii*)	2
Rubus neomexicanus	4
Rubus parviflorus	81
Rubus strigosus (*R. idaeus* var. *strigosus*)	32
Salix spp.	4
Salix bebbiana (*S. depressa*)	1
Salix scouleriana	49
Salix subcoerulea (*S. drummondiana*)	1
Sambucus spp.	17
Shepherdia canadensis	5
Sorbus dumosa	12
Symphoricarpos oreophilus	60
Toxicodendron rydbergii (*T. radicans, Rhus radicans*)	11
Vaccinium myrtillus (*V. oreophilum*)	33
Vitis arizonica	6
Yucca baccata	22
Yucca schottii	1

Graminoids

Agropyron spp. (probably *A. smithii*)	5
Agropyron arizonicum	18
Agropyron trachycaulum	4
Agrostis spp.	4
Agrostis alba (*A. gigantea*)	2
Agrostis scabra	7
Andropogon spp.	21
Andropogon cirratus (*Schizachyrium cirratum*)	4
Andropogon gerardi	2
Andropogon scoparius (*Schizachyrium scoparium*)	5
Aristida spp.	2
Aristida arizonica	32
Aristida orcuttiana	1
Aristida fendleriana	1
Aristida wrightii	1
Blepharoneuron tricholepis	102
Bouteloua curtipendula	8
Bouteloua gracilis	57
Bromus spp.	71
Bromus anomalous (*Bromopsis porteri*)	13
Bromus carinatus	5
Bromus ciliatus (*B. richardsonii*, *Bromopsis ciliata*)	236
Bromus frondosus (*Bromopsis frondosa*)	8
Bromus inermis (*Bromopsis inermis*)	2
Bromus japonicus	1
Bromus lanatipes (*Bromopsis lanatipes*)	5
Bromus marginatus (*Ceratochloa marginata*)	14
Bromus orcuttianus	1
Calamagrostis canadensis	1
Calamagrostis inexpansa (*C. neglecta*)	3
Carex spp.	191
Carex aurea	2
Carex bella	1
Carex festivella	1
Carex foenea	88
Carex geophila	4
Carex lanuginosa	1
Carex media (*C. norvegica* ssp. *stevenii*)	1
Carex microptera	4
Carex occidentalis	14
Carex praegracilis	1
Carex rossii	102
Cyperus spp.	2
Cyperus aristatus (*Cyperus inflexus*)	1
Cyperus rusbyi	12
Danthonia spp.	1
Danthonia californica	1
Elymus glaucus	3
Festuca arizonica	89
Festuca ovina (*F. brachyphylla*)	1
Festuca sororia	23

Festuca thurberi	3
Glyceria elata	4
Glyceria grandis (*G. maxima* spp. *grandis*)	1
Glyceria striata	2
Juncus interior (*J. tenuis*)	1
Juncus longistylis	1
Koeleria nitida (*K. cristata, K. macrantha, K. pyramidata*)	212
Luzula parviflora	3
Lycurus phleoides	14
Melica porteri	6
Muhlenbergia longiligula	27
Muhlenbergia minutissima	1
Muhlenbergia montana	110
Muhlenbergia monticola	1
Muhlenbergia pauciflora	4
Muhlenbergia racemosa	5
Muhlenbergia repens	1
Muhlenbergia rigens	21
Muhlenbergia virescens	129
Muhlenbergia wrightii	8
Panicum bulbosum	1
Phleum pratensis	1
Piptochaetium fimbriatum	7
Poa spp.	1
Poa compressa	3
Poa fendleriana	236
Poa nervosa var *tracyi* (*P. traceyi, P. wheeleri*)	1
Poa palustris	2
Poa pratensis	25
Schizachne purpurascens	2
Scirpus microcarpus (*S. microcarpa*)	3
Setaria geniculata	5
Sitanion hystrix (*S. longifolium*)	182
Sporobolus cryptandrus	1
Stipa spp.	1
Stipa pringlei	16
Trisetum montanum (*T. spicatum* ssp. *montanum*)	49

Forbs

Achillea millefolium (*A. lanulosa*)	185
Aconitum columbianum	3
Actaea rubra ssp. *arguta* (*A. arguta*)	15
Agastache pallidiflora	16
Agave parryi	4
Ageratina herbacea (*Eupatorium herbaceum*)	14
Agoseris aurantiaca	7
Agrimonia striata	7
Allium spp.	4
Allium cernuum	30
Allium gooddingii	2
Allium kunthii	2
Allium rhizomatum	4
Amaranthus spp.	2
Anaphalis margaritacea	1
Androsace occidentalis	3
Antennaria spp.	16
Antennaria marginata (*A. neglecta*)	41
Antennaria parvifolia (*A. aprica*)	56
Anthericum torreyi	3
Apocynum spp.	8
Aquilegia spp.	5
Aquilegia chrysantha	6
Aquilegia elegantula	25
Aquilegia triternata (*A. barnebyi*)	19
Arabis spp.	27
Arabis fendleri	1
Arenaria spp.	15
Arenaria lanuginosa (*A. confusa, A. saxosa*)	23
Artemisia campestris ssp. *pacifica* (*A. pacifica*)	9
Artemisia carruthii	58
Artemisia dracunculus (*A. dracunculoides*)	8
Artemisia franserioides	88
Artemisia frigida	4
Artemisia ludoviciana	95
Asclepias spp.	3
Asclepias asperula (*A. capricornu*)	1
Asclepias speciosa	1
Asclepias tuberosa	2
Aster spp.	5
Aster commutatus[3] (*A. falcatus*)	5
Astragalus spp.	30
Astragalus cobrensis	1
Astragalus egglestonii	7
Astragalus gilensis	27
Astragalus humistratus	11
Astragalus rusbyi	2
Athyrium filix-femina	2
Bahia dissecta	38
Besseya plantaginea	1
Bidens spp.	6
Bistorta bistortoides (*Polygonum bistortoides*)	1
Brickellia spp.	55
Brickellia brachyphylla	1
Brickellia fendleri	5
Brickellia grandiflora	6
Calypso bulbosa	5
Campanula rotundifolia	46
Cardamine cordifolia	2
Castilleja spp.	51
Castilleja miniata (*C. confusa*)	3

Cerastium spp.	2
Cerastium nutans	4
Cerastium brachypodum (*C. nutans* var. *brachypodum*)	1
Cerastium texanum	2
Chaptalia alsophila	17
Cheilanthes spp. (Some species synonymous with some *Notholaena* spp.)	2
Cheilanthes fendleri	2
Chenopodium spp.	6
Chenopodium aff. album	4
Chenopodium graveolens	9
Cicuta douglasii[2] (*C. maculata*)	2
Circaea alpina	5
Cirsium spp.	91
Cirsium arizonicum	7
Cirsium calcareum (*C. pulchellum*)	5
Cirsium parryi	10
Cirsium wheeleri	4
Clematis ligusticifolia	9
Clematis pseudoalpina (*C. columbiana*)	66
Cologania longifolia (*C. angustifolia*)	20
Commelina dianthifolia	19
Conopholis mexicana (*C. alpina*)	6
Conyza schiedeana	4
Corallorhiza spp.	6
Corallorhiza maculata	34
Corallorhiza striata	2
Corallorhiza wisteriana	2
Coryphantha spp. (Some species synonymous with some *Mammillaria* spp.)	1
Cosmos bipinnatus (*C. parviflorus*)	2
Crotalaria pumila	1
Cryptantha spp.	1
Cryptantha jamesii	11
Cucurbita foetidissima	1
Cystopteris fragilis	36
Dalea spp.	1
Dalea filiformis	3
Dalea ordiae	2
Dalea polygonoides	7
Delphinium tenuisectum	2
Descurainia spp.	1
Desmanthus cooleyi	4
Desmodium spp.	1
Desmodium cf. cinerascens	1
Desmodium grahami	2
Desmodium rosei	1
Disporum trachycarpum	16
Draba spp.	3
Draba asprella	2
Draba aurea	3
Draba helleriana	47
Dryopteris filix-mas	2
Dugaldia hoopesii (*Helenium hoopesii*)	64
Echinocereus spp. (*Mammillaria* spp.)	13
Epilobium adenocaulon	3
Epilobium angustifolium (*Chamerion angustifolium*)	39
Equisetum spp.	7
Equisetum arvense	1
Equisetum laevigatum (*Hippochaete laevigata*)	2
Erigeron spp.	17
Erigeron concinnus	2
Erigeron delphinifolius (*E. neomexicanus*)	38
Erigeron divergens	9
Erigeron eximius (*E. superbus*)	125
Erigeron flagellaris	63
Erigeron formosissimus	37
Erigeron platyphyllus	67
Erigeron speciosus var. *speciosus*	4
Eriogonum alatum	42
Eriogonum hieracifolium	1
Eriogonum jamesii	17
Eriogonum pharnaceoides	1
Eriogonum racemosum	2
Erysimum capitatum	20
Erythrocoma triflora (*Geum triflorum*)	1
Euphorbia spp.	17
Euphorbia chamaesula	4
Euphorbia lurida	4
Euphorbia palmeri	5
Euphorbia robusta	1
Fragaria americana (*F. bracteata, F. vesca*)	88
Fragaria ovalis (*F. virginiana* var *glauca*)	165
Gaillardia spp.	1
Galium spp.	28
Galium fendleri	28
Galium mexicanum (*G. asperrimum*)	3
Galium triflorum	5
Galium wrightii	1
Gaura hexandra (*G. gracilis*)	9
Gentiana bigelovii (*Pneumonanthe affinis*)	5
Gentianella amarella ssp. *acuta* (*Gentiana strictiflora*)	17
Geranium spp.	16
Geranium caespitosum (*G. fremontii*)	133
Geranium lentum	1
Geranium richardsonii	149
Geum aleppicum ssp. *strictum* (*G. strictum*)	4
Gnaphalium spp.	25

Gnaphalium macounii (*G. viscosum*)	3
Goodyera oblongifolia	67
Goodyera repens	14
Grindelia spp.	1
Gutierrezia wrightii (*Xanthocephalum wrightii*)	1
Habenaria spp. (*Limnorchis* spp.)	10
Habenaria hyperborea (*Limnorchis hyperborea*)	1
Hackelia ursina	6
Halenia recurva	12
Haplopappus parryi (*Oreochrysum parryi, Solidago parryi*)	162
Hedeoma spp.	2
Hedeoma hyssopifolium	2
Hedeoma oblongifolium	9
Hedyotis pygmaea (*Houstonia wrightii*)	40
Helianthella parryi	10
Helianthella quinquenervis	14
Helianthus spp.	1
Heterotheca fulcrata (*H. villosa, Chrysopsis fulcrata, C. villosa* var. *foliosa,*)	15
Heuchera spp.	21
Heuchera novomexicana	2
Hieracium fendleri	88
Hieracium rusbyi	4
Hydrophyllum fendleri (*H. occidentale*)	1
Hymenopappus filifolius (*H. lugens*)	1
Hymenopappus mexicanus	18
Hymenopappus radiatus	15
Hymenoxys richardsonii	14
Hypericum formosum	3
Ipomoea spp.	6
Ipomoea costellata	3
Ipomopsis aggregata (*Gilia aggregata*)	82
Iris missouriensis	26
Kuhnia chlorolepis (*K. rosmarinifolia, Brickellia chlorolepis*)	12
Lactuca graminifolia	2
Lappula redowskii	2
Lathyrus spp.	4
Lathyrus arizonicus	170
Lathyrus graminifolius	46
Lathyrus leucanthus (*L. lanzwertii*)	4
Lepidium densiflorum	3
Lepidium virginicum (*L. medium*)	1
Leucelene ericoides (*Aster arenosus, A. hirtifolius*)	5
Ligusticum porteri	36
Limnorchis hyperborea (*Habenaria hyperborea*)	1
Linathus nuttallii (*Linanthastrum nuttallii*)	6
Linum spp. (annuals)	15
Linum aristatum	1
Linum lewisii	19
Linum neomexicanum	2
Lithospermum cobrense	5
Lithospermum multiflorum	153
Lobelia anatina	2
Lotus spp.	2
Lotus wrightii	61
Lotus X nummularius (*L. wrightii X rigidus, Hosackia rigida*)	2
Lupinus spp.	15
Lupinus kingii	6
Lupinus neomexicanus	5
Machaeranthera bigelovii (*M. pattersonii, Aster bigelovii*)	4
Machaeranthera pinnatifida (*Haplopappus spinulosus*)	2
Macromeria viridiflora	7
Malaxis ehrenbergii	7
Malaxis soulei (*M. macrostachya*)	14
Mammillaria spp. (Some species synonymous with some *Coryphantha* spp.)	3
Mertensia franciscana	35
Mimulus guttatus	3
Monarda austromontana	1
Monarda menthaefolia (*M. fistulosa* var. *menthaefolia*)	15
Monardella odoratissima	1
Moneses uniflora (*Pyrola uniflora*)	6
Monotropa latisquama (*M. hypopitys* var. *latisquama*)	11
Oenothera spp.	4
Oenothera hookeri	3
Oenothera laciniata (*O. pubescens*)	9
Opuntia spp. (prickly pears)	12
Opuntia phaeacantha (*O. engelmannii*)	1
Opuntia spinosior	1
Orthocarpus luteus	1
Orthocarpus purpureo-albus	1
Osmorhiza depauperata (*O. obtusa*)	57
Oxalis metcalfei (*O. alpina*)	53
Oxybaphus comatus (*Mirabelis oblongifolia*)	3
Oxybaphus linearis (*Mirabelis linearis*)	12
Oxypolis fendleri	3
Oxytropis lambertii	19
Pedicularis spp.	2
Pedicularis angustifolia (*P. angustissima*)	12
Pedicularis centranthera	4

Pedicularis grayi	25
Pedicularis racemosa	3
Penstemon spp.	21
Penstemon barbatus	123
Penstemon deaveri (*P. virgatus* ssp. *arizonicus*)	4
Penstemon linarioides	2
Penstemon oliganthus (*P. griffinii*)	10
Penstemon pinifolius	12
Penstemon virgatus (*P. putus*)	2
Penstemon whippleanus	3
Pericome caudata	2
Petalostemon candidum (*Dalea candida* var. *oligophylla*, *Dalea oligophylla*)	11
Phacelia spp.	15
Phaseolus spp.	1
Phaseolus metcalfei	9
Plantago major	1
Plantago patagonica (*P. purshii*)	3
Polemonium spp.	6
Polygonum sawatchensis	4
Potentilla spp.	20
Potentilla concinna	1
Potentilla crinita	11
Potentilla gracilis var. *pulcherrima*	22
Potentilla hippiana	22
Potentilla pennsylvanica	3
Potentilla thurberi	18
Primula ellisiae	8
Prunella vulgaris	12
Pseudocymopteris montanus	205
Pseudostellaria jamesiana (*Stellaria jamesiana*)	2
Psoralea tenuiflora	3
Pteridium aquilinum	108
Pterospora andromeda	10
Pyrola chlorantha (*P. virens*)	65
Pyrola picta	24
Ramischia secunda (*Pyrola secunda*, *Orthilia secunda*)	74
Ranunculus spp.	3
Ranunculus hydrocharoides	1
Ranunculus inamoenus	1
Ratibida columnaris	2
Rudbeckia laciniata	4
Rumex acetosella (*Acetosella vulgaris*)	4
Rumex crispus	2
Rumex occidentalis	3
Salvia davidsonii	1
Saxifraga spp.	2
Scrophularia parviflora	2
Sedum spp.	19
Senecio spp. (*Packera* spp.)	10
Senecio actinella	12
Senecio bigelovii (*Ligularia bigelovii*)	33
Senecio cardamine	40
Senecio cynthioides	25
Senecio douglasii	1
Senecio eremophilus	11
Senecio neomexicanus	145
Senecio quaerens	9
Senecio wootonii	137
Sidalcea neomexicana	2
Silene laciniata	17
Silene scouleri	30
Sisymbrium spp. (Some species synonymous with *Thelypodiopsis* spp.)	3
Sisymbrium altissimum	5
Sisymbrium linearifolium (*Thelypodiopsis linearifolia*)	45
Sisyrinchium arizonicum	1
Sisyrinchium demissum (*S. angustifolium*)	1
Smilacina racemosa	102
Smilacina stellata	116
Solanum spp.	1
Solidago spp.	59
Solidago missouriensis	1
Solidago sparsiflora	3
Solidago spathulata var. *neomexicana* (*S. decumbens*)	3
Solidago wrightii	7
Sonchus asper	1
Sphaeralcea coccinea	17
Spiranthes parasitica	2
Stachys coccinea	3
Stellaria spp.	7
Stellaria longifolia	3
Stellaria longipes (*S. laeta*)	1
Stephanomeria exigua	1
Stevia spp.	11
Stevia plummerae	1
Stevia serrata	1
Streptopus amplexifolius	1
Swertia radiata (*Frasera speciosa*)	43
Taraxacum spp.	19
Thalictrum fendleri	167
Thermopsis pinetorum (*T. divaricarpa*, *T. rhombifolia*)	49
Thlaspi montanum var. *montanum* (*T. alpestre*, *T. fendleri*)	58
Townsendia formosa	31
Tradescantia pinetorum	11
Tragia stylaris (*T. ramosa*)	11
Tragopogon spp.	6
Trifolium spp.	6
Trifolium longipes (*T. neurophyllum*)	1
Urtica spp.	1
Valeriana spp.	2

Valeriana capitata (*V. capitata* ssp. *acutiloba*, *V. arizonica*)	41
Valeriana edulis	10
Veratrum californicum	2
Verbascum thapsus	9
Verbena spp.	2
Verbena macdougalii	2
Veronica spp.	1
Veronica americana	1
Veronica peregrina	1
Veronica serphyllifolia	1
Vicia spp.	4
Vicia americana	144
Vicia leucophaea	11
Vicia pulchella	57
Viguiera spp.	2
Viguiera cordifolia	7
Viguiera multiflora (*Heliomeris multiflora*)	33
Viola canadensis	154
Viola nephrophylla	6
Woodsia spp. (*W. plummerae*)	7
Zygadenus spp.	9
Zygadenus elegans (*Anticlea elegans*)	37
Zygadenus virescens	5

[1]Because sampling was not statistically proportional, the frequency of a given species cannot be obtained in the usual manner whereby occurrences (number of plots in which a species is found) is divided by the total number of plots sampled. A zero value indicates presence in the stand, but outside the sample plot.

[2]These two are distinct species, but the two names both have been misapplied to the other species (S.C.S. 1982a 1982b).

[3]The preferred name for most varieties of this species is *Aster falcatus*, but our herbarium specimens were identified only as "*A. commutatus*" and varietal correspondence was not possible.

Appendix C. Successional Status of Major Tree Species Within Habitat Types on the Apache, Gila, and Cibola (Magdalena District) National Forests[1]

		PIEN	ABLA	ABCO	PIPU	PSME	PIST	POTR	PIPO	PIED	JUDE	JUMO	JUSC	QUGA	QUGR	ACNE	ALOB	JUMA	POAN
1.	PIEN/Moss	C		a		S	S	s											
2.	PIEN/VAMY	C		a		S	S	S											
3.	PIEN/SECA																		
	ABLA phase	C	C	s	s	S	s	S											
	ABCO phase	C	c	S	s	S	s	S	a										
4.	PIEN/EREX	C	a	c	s	C	s	S	s										
5.	ABLA/VAMY																		
	VAMY (typic) phase	C	C			s	s	s											
	RUPA phase	C	C	s	a	S	s	S											
6.	ABLA/LAAR	C	C			S	S	S											
7.	ABLA/HODU (Scree)	c	C			C	C	s											
8.	ABLA/EREX	C	C	s	s	S	s	S											
9.	ABLA/RUPA	C	C	S		S	s	S											
10.	PIPU/SECA	c	c	S	C	S	S	s											
11.	PIPU/EREX	c	a	c	C	C	S	S	s										
12.	PIPU/CAFO	c	a		C	C	S	S	S										
13.	PIPU/FEAR	a	a	c	C	C	s	s	S										
14.	PIPU/POPR	c			C	C	s	s											
15.	ABCO/EREX	a	a	C	a	C	S	S	s										
16.	ABCO/Sparse	a	a	C		C	S	s	s										
17.	ABCO/HODU (Scree)			C		C	S	S	S										
18.	ABCO/ACGL	a	a	C	a	C	S	S	s										
19.	ABCO/MUVI			C	a	C	S	s	S					s					
20.	ABCO/QUGA																		
	QUGA (typic) phase			C	a	C	S		S					S					
	MUVI phase			C		C	S		S					S					
21.	ABCO/RONE	a		C		C	S	S	S										
22.	ABCO/FEAR																		
	FEAR (typic) phase			C		C	s	s	s										
	POFE phase			C	a	C	s	s	s										
23.	ABCO/ACGR			C		c		s	s							c			
24.	ABCO/JUMA			C		c			S					C		c		C	
25.	PSME/ARUV					C	C	S	S										
26.	PSME/HODU (Scree)					C	C	s											
27.	PSME/FEAR			a		C	S	s	S	a									
28.	PSME/BRCI			a		C	S	S	a										
29.	PSME/QUGA																		
	QUGA (typic) phase			a		C	s		S	s	s		s	S					
	MUVI phase			a		C	s		c		a			S					
	FEAR phase			a		C	s		C	s				S					
30.	PSME/MUVI			a	a	C	S	s	S	a	s								
31.	PSME/MUMO			a		C	s		S	s	s		s						
32.	PSME/QUHY			a		C	s		C	s				s					
33.	PIPO/MUVI																		
	MUVI (typic) phase					a	c		C	a	a								
	QUGA phase			a		c	c		C	s	s			S					
34.	PIPO/MUVI-FEAR																		
	MUVI-FEAR (typic) phase					a	a		C	a	s								
	QUGA phase								C	a				S					
	BOGR phase								C	s	s								
35.	PIPO/QUGR																		
	MUMO phase					c	a		C	c	c	a			C				
	MULO phase					a			C	C	C				C				
36.	PIPO/Rockland					c	a		C	c	c				c				
37.	PIPO/FEAR																		
	FEAR (typic) phase								C	a	a								
	QUGA phase								C	a	s			S					
	BOGR phase								C	s	s								
38.	PIPO/MUMO					a			C	S	S	a		s	s				
39.	PIPO/QUGA																		
	QUGA (typic) phase					a			C	s	s			S					
	MULO phase					a			C	s	s			S					
40.	PIPO/BOGR																		
	PIED phase								C	C	C	s		s	s				
	VIAR phase								C		C				S				
41.	PIPO/ARPU CT								C	s	C			S					
42.	POAN Series			c		c			s	a	s		c	S		c	c	c	c

[1]Successional status interpreted from sample data, and some variation can be expected. An upper case letter indicates that a species was found on most plots in the habitat type. A lower case letter indicates that a species was found infrequently. Climax status is indicated by either C or c, and seral status by S or s.

Appendix D. Average density and constancy of major tree species and average cover and constancy of major herbaceous species within each habitat type on the Apache, Gila, and Cibola (Magdalena District) National Forests

Table 1.--Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Picea engelmannii series.

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees										
Abies concolor - Young regen.			3	33	4	63	23	100	15	57
Abies concolor - Advance regen.	<1	33	1	33	1	38	3	58	1	57
Abies concolor - Mature							<1	25	<1	29
Abies lasiocarpa - Young regen.					28	100	1	42	<1	14
Abies lasiocarpa - Advance regen.					4	88			<1	14
Abies lasiocarpa - Mature					3	100	<1	8		
Alnus oblongifolia - Young regen.										
Alnus oblongifolia - Advance regen.										
Alnus oblongifolia - Mature										
Juniperus deppeana - Young regen.										
Juniperus deppeana - Advance regen.										
Juniperus deppeana - Mature										
Juniperus osteosperma - Young regen.										
Juniperus osteosperma - Advance regen.										
Juniperus osteosperma - Mature										
Juniperus scopulorum - Young regen.										
Juniperus scopulorum - Advance regen.										
Juniperus scopulorum- Mature										
Picea engelmannii - Young regen.	22	100	45	100	10	100	23	100	32	100
Picea engelmannii - Advance regen.	18	100	23	100	6	88	9	100	13	100
Picea engelmannii - Mature	5	67	6	100	3	88	3	100	4	86
Picea pungens - Young regen.					1	38	2	67	6	43
Picea pungens - Advance regen.					<1	38	1	42	5	57
Picea pungens - Mature					<1	25	<1	33	<1	14
Pinus edulis - Young regen.										
Pinus edulis - Advance regen.										
Pinus edulis - Mature										
Pinus ponderosa - Young regen.							<1	8		
Pinus ponderosa - Advance regen.					<1	13				
Pinus ponderosa - Mature					<1	13	<1	17	<1	29
Pinus strobiformis - Young regen.	13	100	10	100	1	38	2	50	2	43
Pinus strobiformis - Advance regen.	6	67	1	67	1	50	2	50	<1	29
Pinus strobiformis - Mature	1	67	<1	33			<1	42		

(Continued)

Table 1.–(continued).

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Populus angustifolia - Young regen.										
Populus angustifolia - Advance regen.										
Populus angustifolia - Mature										
Populus tremuloides - Young regen.										
Populus tremuloides - Advance regen.	2	100	2	33					3	43
Populus tremuloides - Mature	<1	67	5	67	2	50	1	50	1	71
Pseudotsuga menziesii - Young regen.	4	67	21	100	9	100	10	100	13	100
Pseudotsuga menziesii - Advance regen.	11	67	1	67	2	75	3	83	4	86
Pseudotsuga menziesii - Mature	5	67	3	67	4	100	3	92	3	86
Shrubs										
Acer glabrum	2	33	<1	67			<1	25		
Acer grandidentatum										
Acer negundo										
Alnus oblongifolia										
Berberis repens										
Calliandra humilis										
Ceanothus fendleri										
Cercocarpus montanus										
Chimaphila umbellata					<1	25	<1	8		
Cornus stolonifera							<1	8		
Fraxinus pennsylvanica										
Garrya wrightii										
Gutierrezia sarothrae										
Holodiscus dumosus	<1	33								
Hymenoxys richardsonii										
Jamesia americana			<1	100						
Juglans major										
Juniperus communis	2	67	2	33						
Lonicera albiflora										
Lonicera arizonica	<1	67	<1	33	<1	13	<1	8		
Nolina microcarpa										
Parthenocissus vitacea										
Philadelphus spp.										
Physocarpus monogynus	<1	67	<1	33			<1	25		

(Continued)

Table 1.–(continued).

HTs: / No. plots:	PIEN/Moss (3)		PIEN/VAMY (3)		PIEN/SECA ABLA ph. (8)		PIEN/SECA ABCO ph. (12)		PIEN/EREX (7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Populus tremuloides - shrubs	<1	67	<1	33	<1	75	<1	67	<1	86
Ptelea trifoliata										
Prunus emarginata										
Prunus virginiana									<1	14
Quercus chrysolepis										
Quercus emoryi										
Quercus gambelii										
Quercus grisea										
Quercus hypoleucoides										
Quercus rugosa										
Rhamnus betulaefolia										
Rhus glabra										
Rhus trilobata										
Ribes cereum										
Ribes montigenum										
Ribes pinetorum	<1	33	<1	33			<1	17		
Ribes wolfii	<1	33	<1	33						
Robinia neomexicana					<1	38	<1	25		
Rosa spp.							<1	25		
Rubus arizonensis										
Rubus parviflorus					<1	63	<1	67	<1	43
Rubus strigosus					<1	13	<1	17		
Salix bebbiana										
Salix scouleriana			1	33	<1	25			2	57
Salix spp.										
Sambucus spp.										
Shepherdia canadensis										
Sorbus dumosa					<1	13				
Symphoricarpus oreophilus							<1	8		
Toxicodendron rydbergii										
Vaccinium myrtillus	<1	33	14	100						
Vitis arizonica										
Yucca baccata										
Yucca schottii										

(Continued)

Table 1.–(continued).

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Graminoids										
Agropyron arizonicum										
Agropyron (smithii?)										
Agrostis alba										
Andropogon spp.										
Andropogon cirratus										
Andropogon gerardi										
Andropogon scoparius										
Aristida spp.										
Aristida arizonica										
Aristida fendleriana										
Blepharoneuron tricholepis										
Bouteloua curtipendula										
Bouteloua gracilis										
Bromus anomalous									<1	14
Bromus carinatus										
Bromus ciliatus	<1	67	<1	67	<1	100	4	100	10	100
Bromus frondosus										
Bromus lanatipes										
Bromus spp.										
Calamagrostis canadensis										
Carex spp.	<1	33	<1	67					<1	43
Carex foenea					1	63	1	75	10	71
Carex lanuginosa										
Carex microptera										
Carex occidentalis										
Carex rossii					<1	75	<1	83	<1	14
Cyperus rusbyi										
Cyperus sp.										
Elymus glaucus										
Festuca arizonica									3	29
Festuca sororia					<1	38	<1	50	<1	43
Glyceria elata										
Glyceria striata										

(Continued)

Table 1.--(continued).

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Koeleria nitida					<1	13	<1	50	<1	14
Luzula parviflora										
Lycurus phleoides										
Melica porteri							<1	8		
Muhlenbergia longiligula										
Muhlenbergia montana									<1	14
Muhlenbergia monticola										
Muhlenbergia paucifiora										
Muhlenbergia rigens										
Muhlenbergia virescens							<1	8	1	14
Muhlenbergia wrightii										
Panicum bulbosum										
Piptochaetium fimbriatum										
Poa compressa										
Poa fendleriana					<1	13	<1	42	<1	29
Poa nervosa var tracyi										
Poa pratensis							<1	17	1	29
Sitanion hystrix							<1	25	<1	14
Sporobolus cryptandrus										
Stipa spp.										
Stipa pringlei										
Trisetum montanum			<1	33	<1	38	<1	25	<1	29
Forbs										
Achillea millefolium					<1	13	<1	25	<1	43
Actaea rubra ssp. arguta							<1	17		
Agrimonia striata										
Allium cernuum										
Allium kunthii										
Allium rhizomatum										
Antennaria marginata										
Antennaria parvifolia			<1	33						
Antennaria spp.							<1	8		
Aquilegia chrysantha										

(Continued)

Table 1.–(continued).

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Aquilegia elegantula					<1	38	<1	33	<1	29
Aquilegia triternata					<1	13	<1	8	<1	43
Arabis spp.										
Arenaria lanuginosa	<1	33			<1	13			<1	14
Arenaria spp.									<1	29
Artemisia carruthii										
Artemisia dracunculoides										
Artemisia franserioides					<1	25	<1	17	<1	29
Artemisia frigida										
Artemisia ludoviciana										
Asclepias spp.										
Aster falcatus										
Astragalus egglestonii										
Astragalus gilensis										
Astragalus humistratus										
Astragalus spp.										
Bahia dissecta										
Brickellia brachyphylla										
Brickellia fendleri										
Brickellia grandiflora										
Brickellia spp.										
Calypso bulbosa										
Campanula rotundifolia					<1	13	<1	17		
Cardamine cordifolia										
Castilleja spp.									<1	14
Chaptalia alsophila									<1	14
Chamerion angustifolium			<1	33	<1	25	<1	8	<1	14
Cicuta douglasii										
Circaea alpina										
Cirsium spp.					<1	13			<1	14
Cirsium parryi										
Cirsium wheeleri										
Clematis ligusticifolia										
Clematis pseudoalpina	<1	67	<1	67	<1	13	<1	8		

(Continued)

Table 1.–(continued).

HTs: / No. plots:	PIEN/Moss (3) D/C	CON	PIEN/VAMY (3) D/C	CON	PIEN/SECA ABLA ph. (8) D/C	CON	PIEN/SECA ABCO ph. (12) D/C	CON	PIEN/EREX (7) D/C	CON
Cologania longifolia										
Commelina dianthifolia										
Corallorhiza spp.					<1	13				
Corallorhiza maculata					<1	13	<1	17	<1	29
Cryptantha jamesii										
Cucurbita foetidissima										
Cystopteris fragilis					<1	13			<1	14
Delphinium tenuisectum										
Desmanthus cooleyi										
Disporum trachycarpum					<1	13	<1	17	<1	14
Draba helleriana										
Dugaldia hoopesii					2	88	<1	67	<1	29
Equisetum arvense										
Equisetum laevigatum										
Erigeron concinnus										
Erigeron delphinifolius										
Erigeron divergens										
Erigeron eximius	<1	33	<1	100	<1	50	2	83	7	86
Erigeron flagellaris							<1	8		
Erigeron formosissimus							<1	8	<1	14
Erigeron platyphyllus							<1	8		
Eriogonum alatum										
Eriogonum jamesii										
Erysimum capitatum										
Fragaria americana					1	13	2	50		
Fragaria ovalis	<1	67	<1	67	<1	100	<1	92	2	71
Galium spp.										
Galium fendleri										
Galium mexicanum										
Gaura hexandra										
Gentianella amarella s. acuta					<1	13	<1	33		
Geranium caespitosum										
Geranium richarsonii					<1	88	1	100	3	100
Geranium spp.					<1	13				

(Continued)

Table 1.–(continued).

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Geum aleppicum ssp. strictum										
Gnaphalium macounii										
Goodyera oblongifolia					<1	50	<1	50	<1	29
Goodyera repens			<1	100			<1	17		
Halenia recurva					<1	38	<1	17		
Haplopappus parryi	<1	33	<1	67			<1	17	<1	71
Hedeoma oblongifolium										
Hedyotis pygmea										
Helianthella parryi										
Heterotheca fulcrata										
Hieracium fendleri									<1	14
Hydrophyllum fendleri										
Hymenopappus filifolius										
Hymenopappus mexicanus										
Hypericum formosum										
Ipomopsis aggregata										
Iris missouriensis							<1	17		
Kuhnia chlorolepis										
Lactuca graminifolia										
Lathyrus arizonicus					<1	50	3	92	6	100
Lathyrus graminifolius										
Leucelene ericoides										
Ligusticum porteri			<1	33	<1	25	<1	17	<1	43
Linum lewisii										
Lithospermum multiflorum					<1	13	<1	17	<1	14
Lobelia anatina										
Lotus wrightii										
Lupinus neomexicanus										
Lupinus spp.										
Malaxis ehrenbergii										
Malaxis soulei										
Mertensia franciscana					<1	13	<1	42	<1	14
Monarda menthaefolia										
Opuntia spp. (prickly pears)										

(Continued)

Table 1.–(continued).

HTs: ..... PIEN/Moss			PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Osmorhiza depauperata					<1	63	<1	50	<1	29
Oxalis metcalfei					<1	13	<1	8	<1	14
Oxybaphus linearis										
Oxypolis fendleri										
Oxytropis lambertii										
Pedicularis angustifolia										
Pedicularis grayii									<1	14
Pedicularis racemosa										
Penstemon barbatus										
Penstemon linarioides										
Penstemom oliganthus										
Penstemon pinifolius										
Penstemon whippleanus										
Petalostemom candidum									<1	14
Polygonum sawatchensis										
Potentilla crinita										
Potentilla gracilis v pulcher									<1	14
Potentilla hippiana										
Potentilla spp.										
Potentilla thurberi							<1	8		
Prunella vulgaris					<1	25	<1	8		
Pseudocymopteris montanus	<1	33			<1	13	<1	50	<1	86
Pseudostellaria jamesiana										
Psoralea tenuiflora										
Pteridium aquilinum					4	75	1	83	<1	43
Pterospora andromeda										
Pyrola chlorantha	<1	67	<1	67	<1	63	<1	67	<1	43
Pyrola picta							<1	8		
Ramischia secunda	<1	33	<1	100	<1	88	<1	75	<1	43
Ratibida columnaris										
Rudbeckia laciniata										
Rumex acetosella										
Rumex crispus										
Rumex occidentalis										
Senecio actinella										

(Continued)

Table 1.--(continued).

HTs:	PIEN/Moss		PIEN/VAMY		PIEN/SECA ABLA ph.		PIEN/SECA ABCO ph.		PIEN/EREX	
No. plots:	(3)		(3)		(8)		(12)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Senecio bigelovii					<1	13	<1	8	<1	14
Senecio cardamine					17	88	11	100		
Senecio cynthioides										
Senecio eremophilus										
Senecio neomexicanus									<1	14
Senecio quaerens										
Senecio wootoni					1	75	<1	67	<1	43
Sidalcea neomexicana										
Silene laciniata										
Silene scouleri							<1	8		
Sisymbrium linearifolium										
Smilacina racemosa	<1	33	<1	67	<1	50	<1	25	<1	14
Smilacina stellata	<1	33			<1	38	<1	50	1	57
Solidago spathulata var neomex										
Solidago spp.					<1	25	<1	25		
Solidago wrightii										
Sphaeralcea coccinea										
Swertia radiata					<1	13			<1	14
Taraxacum spp.							<1	17		
Thalictrum fendleri					<1	63	<1	58	2	86
Thermopsis pinetorum					<1	13	5	25	2	14
Townsendia formosa							<1	17	<1	14
Tragia stylaris										
Valeriana capitata							<1	8	3	14
Valeriana edulis										
Veratrum californicum										
Verbascum thapsus										
Vicia americana					<1	38	<1	50	1	86
Vicia leucophaea										
Vicia pulchella										
Viguiera multiflora										
Viola canadensis	<1	33	<1	67	<1	100	2	100	2	86
Viola nephrophylla										
Zygadenus elegans	<1	67	<1	67					<1	29
Zygadenus virescens										

Table 2.—Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Abies lasiocarpa series.

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees												
Abies concolor - Young regen.			5	67					3	16	6	100
Abies concolor - Advance regen.			<1	33					<1	12	3	40
Abies concolor - Mature	<1	8	<1	17					<1	8		
Abies lasiocarpa - Young regen.	44	100	37	100	4	100	14	100	52	100	21	100
Abies lasiocarpa - Advance regen.	12	100	10	100	1	100	1	100	8	88	19	100
Abies lasiocarpa - Mature	2	85	2	83			2	100	2	88	2	60
Alnus oblongifolia - Young regen.												
Alnus oblongifolia - Advance regen.												
Alnus oblongifolia - Mature												
Juniperus deppeana - Young regen.												
Juniperus deppeana - Advance regen.												
Juniperus deppeana - Mature												
Juniperus osteosperma - Young regen.												
Juniperus osteosperma - Advance regen.												
Juniperus osteosperma - Mature												
Juniperus scopulorum - Young regen.												
Juniperus scopulorum - Advance regen.												
Juniperus scopulorum- Mature												
Picea engelmannii - Young regen.	37	100	14	100	1	100	1	100	22	92	2	80
Picea engelmannii - Advance regen.	29	100	8	83	1	100			9	92	4	80
Picea engelmannii - Mature	7	100	2	83					4	88	1	40
Picea pungens - Young regen.									<1	24		
Picea pungens - Advance regen.			<1	17					<1	28		
Picea pungens - Mature			<1	17					<1	24		
Pinus edulis - Young regen.												
Pinus edulis - Advance regen.											<1	20
Pinus edulis - Mature												
Pinus ponderosa - Young regen.												
Pinus ponderosa - Advance regen.			<1	17					<1	4		
Pinus ponderosa - Mature									<1	8		
Pinus strobiformis - Young regen.	<1	8	<1	17	7	100			<1	40	<1	40
Pinus strobiformis - Advance regen.	<1	15	<1	50	5	100	5	100	<1	24		
Pinus strobiformis - Mature	<1	8	<1	17	7	100	2	100	<1	24		

(Continued)

Table 2.–(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Populus angustifolia - Young regen.												
Populus angustifolia - Advance regen.												
Populus angustifolia - Mature												
Populus tremuloides - Young regen.												
Populus tremuloides - Advance regen.	<1	8	2	50	3	100	3	100	2	36	4	40
Populus tremuloides - Mature	<1	38	<1	50					3	68	16	60
Pseudotsuga menziesii - Young regen.	<1	15	7	67	5	100	3	100	8	64	7	80
Pseudotsuga menziesii - Advance regen.	<1	23	4	67	1	100	6	100	3	64	2	60
Pseudotsuga menziesii - Mature	<1	31	3	67	1	100	6	100	4	76	3	80
Shrubs												
Acer glabrum	<1	15	6	67	4	100			<1	16	11	100
Acer grandidentatum												
Acer negundo												
Alnus oblongifolia												
Berberis repens												
Calliandra humilis												
Ceanothus fendleri												
Cercocarpus montanus												
Chimaphila umbellata	<1	8	<1	17			<1	100	<1	12	<1	40
Cornus stolonifera			<1	17							3	40
Fraxinus pennsylvanica												
Garrya wrightii												
Gutierrezia sarothrae												
Holodiscus dumosus	<1	8	<1	17			7	100	<1	8	<1	60
Hymenoxys richardsonii												
Jamesia americana											<1	20
Juglans major												
Juniperus communis	<1	15					3	100	<1	36		
Lonicera albiflora												
Lonicera arizonica												
Nolina microcarpa												
Parthenocissus vitacea												
Philadelphus spp.												

(Continued)

Table 2.--(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Physocarpus monogynus			3	67					<1	4	<1	40
Populus tremuloides - shrubs	<1	46	<1	83			<1	100	<1	72	<1	60
Ptelea trifoliata												
Prunus emarginata												
Prunus virginiana									<1	4		
Quercus chrysolepis												
Quercus emoryi												
Quercus gambelii												
Quercus grisea												
Quercus hypoleucoides												
Quercus rugosa												
Rhamnus betulaefolia												
Rhus glabra												
Rhus trilobata												
Ribes cereum												
Ribes montigenum	<1	15										
Ribes pinetorum			<1	67	<1	100			<1	12	<1	60
Ribes wolfii	<1	46	<1	50			<1	100	<1	4	<1	40
Robinia neomexicana	<1	8	<1	50					<1	12	<1	60
Rosa spp.												
Rubus arizonensis												
Rubus parviflorus	<1	23	18	100	<1	100	<1	100	<1	52	8	100
Rubus strigosus	<1	8	<1	17					<1	8	2	40
Salix bebbiana												
Salix scouleriana	<1	23	5	33	4	100	<1	100	<1	16	<1	40
Salix spp.												
Sambucus spp.			<1	17	<1	100			<1	4	<1	20
Shepherdia canadensis									<1	8		
Sorbus dumosa	<1	46	<1	50							<1	20
Symphoricarpus oreophilus	<1	8	<1	17	3	100	13	100	<1	8	<1	20
Toxicodendron rydbergii												
Vaccinium myrtillus	38	100	33	100					<1	8		
Vitis arizonica												
Yucca baccata												
Yucca schottii												

(Continued)

Table 2.–(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Graminoids												
Agropyron arizonicum									< 1	4		
Agropyron (smithii?)												
Agrostis alba												
Andropogon spp.												
Andropogon cirratus												
Andropogon gerardi												
Andropogon scoparius												
Aristida spp.												
Aristida arizonica												
Aristida fendleriana												
Blepharoneuron tricholepis												
Bouteloua curtipendula												
Bouteloua gracilis												
Bromus anomalous												
Bromus carinatus												
Bromus ciliatus	< 1	54	1	83	1	100	1	100	2	100	< 1	80
Bromus frondosus												
Bromus lanatipes												
Bromus spp.												
Calamagrostis canadensis									< 1	12		
Carex spp.			< 1	33			< 1	100	1	32	< 1	20
Carex foenea												
Carex lanuginosa									< 1	4		
Carex microptera												
Carex occidentalis									< 1	52		
Carex rossii	< 1	31										
Cyperus rusbyi												
Cyperus sp.												
Elymus glaucus									< 1	20		
Festuca arizonica									< 1	4		
Festuca sororia	< 1	15										
Glyceria elata												
Glyceria striata												

(Continued)

Table 2.–(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Koeleria nitida									<1	12		
Luzula parviflora	<1	8	<1	17								
Lycurus phleoides												
Melica porteri												
Muhlenbergia longiligula												
Muhlenbergia montana									<1	8		
Muhlenbergia monticola												
Muhlenbergia pauciflora												
Muhlenbergia rigens												
Muhlenbergia virescens									<1	4		
Muhlenbergia wrightii												
Panicum bulbosum												
Piptochaetium fimbriatum												
Poa compressa												
Poa fendleriana									<1	8		
Poa nervosa var tracyi	<1	8										
Poa pratensis									<1	4		
Sitanion hystrix									<1	8		
Sporobolus cryptandrus												
Stipa spp.												
Stipa pringlei												
Trisetum montanum	<1	31	<1	50					<1	48		
Forbs												
Achillea millefolium			<1	17			<1	100	<1	12		
Actaea rubra ssp. arguta			<1	17					<1	8	1	20
Agrimonia striata											<1	20
Allium cernuum												
Allium kunthii												
Allium rhizomatum												
Antennaria marginata												
Antennaria parvifolia									<1	4		
Antennaria spp.												
Aquilegia chrysantha												
Aquilegia elegantula	<1	15							<1	20		

(Continued)

Table 2.–(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Aquilegia triternata	<1	8									<1	40
Arabis spp.												
Arenaria lanuginosa	<1	8							<1	4		
Arenaria spp.									<1	8		
Artemisia carruthii												
Artemisia dracunculoides												
Artemisia franserioides	<1	15	1	67					<1	72	<1	60
Artemisia frigida												
Artemisia ludoviciana												
Asclepias spp.												
Aster falcatus												
Astragalus egglestonii												
Astragalus gilensis												
Astragalus humistratus												
Astragalus spp.												
Bahia dissecta												
Brickellia brachyphylla												
Brickellia fendleri												
Brickellia grandiflora												
Brickellia spp.												
Calypso bulbosa									<1	12		
Campanula rotundifolia									<1	12		
Cardamine cordifolia												
Castilleja spp.					<1	100	<1	100	<1	4		
Chaptalia alsophila												
Chamerion angustifolium	<1	92	<1	67					<1	28	<1	60
Cicuta douglasii												
Circaea alpina											<1	20
Cirsium spp.									<1	4		
Cirsium parryi									<1	4	<1	20
Cirsium wheeleri												
Clematis ligusticifolia												
Clematis pseudoalpina	<1	8	<1	33			<1	100	<1	4	<1	80
Cologania longifolia												

(Continued)

Table 2.–(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Commelina dianthifolia												
Corallorhiza spp.									<1	4	<1	20
Corallorhiza maculata					<1	100			<1	20	<1	20
Cryptantha jamesii												
Cucurbita foetidissima												
Cystopteris fragilis											<1	20
Delphinium tenuisectum												
Desmanthus cooleyi												
Disporum trachycarpum											<1	80
Draba helleriana												
Dugaldia hoopesii	<1	8							<1	36		
Equisetum arvense												
Equisetum laevigatum												
Erigeron concinnus												
Erigeron delphinifolius												
Erigeron divergens												
Erigeron eximius	<1	62	2	83					14	96		
Erigeron flagellaris												
Erigeron formosissimus												
Erigeron platyphyllus												
Eriogonum alatum												
Eriogonum jamesii												
Erysimum capitatum												
Fragaria americana									1	8	<1	20
Fragaria ovalis	<1	46	<1	67	<1	100	<1	100	2	80		
Galium spp.			<1	17								
Galium fendleri												
Galium mexicanum												
Gaura hexandra												
Gentianella amarella s. acuta												
Geranium caespitosum												
Geranium richarsonii	<1	54	8	100	2	100	3	100	2	84	5	100
Geranium spp.												
Geum aleppicum ssp. strictum												

(Continued)

Table 2.--(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Gnaphalium macounii												
Goodyera oblongifolia	<1	23	<1	50					<1	64	<1	80
Goodyera repens			<1	17					<1	4		
Halenia recurva												
Haplopappus parryi	1	100	2	67	2	100	3	100	2	80	<1	20
Hedeoma oblongifolium												
Hedyotis pygmea												
Helianthella parryi												
Heterotheca fulcrata												
Hieracium fendleri									<1	4		
Hydrophyllum fendleri												
Hymenopappus filifolius												
Hymenopappus mexicanus												
Hypericum formosum												
Ipomopsis aggregata												
Iris missouriensis												
Kuhnia chlorolepis												
Lactuca graminifolia												
Lathyrus arizonicus	<1	15	<1	17	20	100			4	72		
Lathyrus graminifolius												
Leucelene ericoides												
Ligusticum porteri	<1	23	<1	17	<1	100			<1	20	<1	40
Linum lewisii												
Lithospermum multiflorum									<1	16		
Lobelia anatina												
Lotus wrightii												
Lupinus neomexicanus												
Lupinus spp.									<1	4		
Malaxis ehrenbergii												
Malaxis soulei												
Mertensia franciscana	<1	15	<1	50					<1	28	3	20
Monarda menthaefolia												
Opuntia spp. (prickly pears)												
Osmorhiza depauperata	<1	15	<1	17					<1	40	<1	80

(Continued)

Table 2.–(continued).

HTs: ..... No. plots:	ABLA/VAMY Typic ph. (13)		ABLA/VAMY RUPA ph. (6)		ABLA/LAAR (1)		ABLA/HODU (1)		ABLA/EREX (25)		ABLA/RUPA (5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Oxalis metcalfei					<1	100						
Oxybaphus linearis												
Oxypolis fendleri												
Oxytropis lambertii												
Pedicularis angustifolia	5	38					<1	100	<1	4		
Pedicularis grayii	<1	8							<1	16		
Pedicularis racemosa	<1	23										
Penstemon barbatus							<1	100				
Penstemon linarioides												
Penstemom oliganthus												
Penstemon pinifolius												
Penstemon whippleanus					<1	100						
Petalostemom candidum												
Polygonum sawatchensis												
Potentilla crinita												
Potentilla gracilis v pulcher									<1	8		
Potentilla hippiana												
Potentilla spp.												
Potentilla thurberi												
Prunella vulgaris												
Pseudocymopteris montanus	<1	31	<1	50	<1	100			<1	56	<1	20
Pseudostellaria jamesiana												
Psoralea tenuiflora												
Pteridium aquilinum	<1	8	<1	17	<1	100	<1	100	<1	56	2	60
Pterospora andromeda												
Pyrola chlorantha	<1	23	<1	17	<1	100	<1	100	<1	36	<1	20
Pyrola picta	<1	23	<1	17			<1	100	<1	4	<1	40
Ramischia secunda	<1	69	<1	83					<1	56	<1	100
Ratibida columnaris												
Rudbeckia laciniata												
Rumex acetosella												
Rumex crispus												
Rumex occidentalis												
Senecio actinella												

(Continued)

Table 2.–(continued).

HTs:	ABLA/VAMY Typic ph.		ABLA/VAMY RUPA ph.		ABLA/LAAR		ABLA/HODU		ABLA/EREX		ABLA/RUPA	
No. plots:	(13)		(6)		(1)		(1)		(25)		(5)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Senecio bigelovii	<1	31							<1	28	<1	20
Senecio cardamine			1	17					<1	8	<1	80
Senecio cynthioides												
Senecio eremophilus									<1	4		
Senecio neomexicanus												
Senecio quaerens												
Senecio wootoni	<1	8							1	44		
Sidalcea neomexicana												
Silene laciniata												
Silene scouleri												
Sisymbrium linearifolium												
Smilacina racemosa	<1	23	<1	50			<1	100	<1	32	<1	60
Smilacina stellata	<1	15	<1	33			<1	100	1	60	<1	40
Solidago spathulata var neomex												
Solidago spp.												
Solidago wrightii												
Sphaeralcea coccinea												
Swertia radiata	<1	8	<1	83	<1	100	<1	100	<1	24	<1	40
Taraxacum spp.												
Thalictrum fendleri					<1	100			<1	36	<1	40
Thermopsis pinetorum			<1	33					<1	8		
Townsendia formosa									<1	4		
Tragia stylaris												
Valeriana capitata			1	33								
Valeriana edulis												
Veratrum californicum												
Verbascum thapsus												
Vicia americana					12	100			<1	56		
Vicia leucophaea												
Vicia pulchella												
Viguiera multiflora												
Viola canadensis	<1	38	<1	67					<1	88	<1	80
Viola nephrophylla											<1	20
Zygadenus elegans			<1	50					<1	8	<1	40
Zygadenus virescens	<1	23							<1	4		

Table 3.—Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Picea pungens series.

HTs:	PIPU/SECA		PIPU/EREX		PIPU/CAFO		PIPU/FEAR		PIPU/POPR	
No. plots:	(4)		(12)		(6)		(8)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees										
Abies concolor - Young regen.	6	100	10	67			<1	13		
Abies concolor - Advance regen.	2	75	3	50			<1	25		
Abies concolor - Mature	2	75	<1	33						
Abies lasiocarpa - Young regen.	2	50	<1	17	<1	50	<1	25		
Abies lasiocarpa - Advance regen.	<1	50								
Abies lasiocarpa - Mature										
Alnus oblongifolia - Young regen.										
Alnus oblongifolia - Advance regen.										
Alnus oblongifolia - Mature										
Juniperus deppeana - Young regen.										
Juniperus deppeana - Advance regen.										
Juniperus deppeana - Mature										
Juniperus osteosperma - Young regen.										
Juniperus osteosperma - Advance regen.										
Juniperus osteosperma - Mature										
Juniperus scopulorum - Young regen.										
Juniperus scopulorum - Advance regen.										
Juniperus scopulorum- Mature										
Picea engelmannii - Young regen.	2	100	<1	25	4	67	1	13		
Picea engelmannii - Advance regen.	<1	50	<1	17	<1	33	<1	13		
Picea engelmannii - Mature	<1	25	<1	8			<1	13		
Picea pungens - Young regen.	2	75	20	100	12	100	10	100	9	100
Picea pungens - Advance regen.	4	100	9	100	9	100	7	100	22	100
Picea pungens - Mature	2	75	1	58	2	33	3	75	3	100
Pinus edulis - Young regen.										
Pinus edulis - Advance regen.										
Pinus edulis - Mature										
Pinus ponderosa - Young regen.			2	33	1	17	2	75		
Pinus ponderosa - Advance regen.	<1	25	<1	25	<1	17	2	50		
Pinus ponderosa - Mature	<1	25	<1	42	3	67	1	88		
Pinus strobiformis - Young regen.	6	100	6	67	3	100	2	63	1	100
Pinus strobiformis - Advance regen.	3	100	3	75	2	33	<1	25		
Pinus strobiformis - Mature			<1	17	<1	17	<1	13		
Populus angustifolia - Young regen.										

(Continued)

Table 3.–(continued).

HTs: / No. plots:	PIPU/SECA (4) D/C	PIPU/SECA (4) CON	PIPU/EREX (12) D/C	PIPU/EREX (12) CON	PIPU/CAFO (6) D/C	PIPU/CAFO (6) CON	PIPU/FEAR (8) D/C	PIPU/FEAR (8) CON	PIPU/POPR (1) D/C	PIPU/POPR (1) CON
Populus angustifolia - Advance regen.										
Populus angustifolia - Mature										
Populus tremuloides - Young regen.										
Populus tremuloides - Advance regen.			<1	25	5	33	1	38		
Populus tremuloides - Mature	1	25	<1	33	2	50	<1	38		
Pseudotsuga menziesii - Young regen.	9	100	32	100	17	100	17	88		
Pseudotsuga menziesii - Advance regen.	8	100	9	100	9	83	6	63	2	100
Pseudotsuga menziesii - Mature	3	75	3	92	3	67	2	75		
Shrubs										
Acer glabrum	<1	25	<1	33			<1	13		
Acer grandidentatum										
Acer negundo										
Alnus oblongifolia										
Berberis repens										
Calliandra humilis										
Ceanothus fendleri							<1	13		
Cercocarpus montanus										
Chimaphila umbellata			<1	8			<1	13		
Cornus stolonifera										
Fraxinus pennsylvanica										
Garrya wrightii										
Gutierrezia sarothrae										
Holodiscus dumosus			<1	8						
Hymenoxys richardsonii										
Jamesia americana			<1	8						
Juglans major										
Juniperus communis			<1	8	6	50				
Lonicera albiflora										
Lonicera arizonica	<1	50	2	33	1	33				
Nolina microcarpa										
Parthenocissus vitacea										
Philadelphus spp.										
Physocarpus monogynus	<1	50	<1	17						
Populus tremuloides - shrubs	<1	25	<1	42	<1	50	<1	63		

(Continued)

Table 3.–(continued).

HTs: ..... PIPU/SECA No. plots: ..... (4)			PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Ptelea trifoliata										
Prunus emarginata										
Prunus virginiana			<1	17						
Quercus chrysolepis										
Quercus emoryi										
Quercus gambelii	<1	25	1	58	<1	17	1	25		
Quercus grisea										
Quercus hypoleucoides										
Quercus rugosa										
Rhamnus betulaefolia										
Rhus glabra										
Rhus trilobata										
Ribes cereum							<1	13		
Ribes montigenum										
Ribes pinetorum	<1	25	<1	25						
Ribes wolfii			<1	8	<1	17				
Robinia neomexicana	<1	25	<1	17	<1	17				
Rosa spp.	<1	25	<1	58	<1	33	<1	38	1	100
Rubus arizonensis										
Rubus parviflorus	<1	75	<1	58	<1	50	<1	13		
Rubus strigosus	<1	25	<1	33	<1	50	<1	38		
Salix bebbiana									<1	100
Salix scouleriana	<1	25	<1	8						
Salix spp.										
Sambucus spp.										
Shepherdia canadensis					<1	17				
Sorbus dumosa										
Symphoricarpus oreophilus										
Toxicodendron rydbergii										
Vaccinium myrtillus	<1	25								
Vitis arizonica										
Yucca baccata										
Yucca schottii										

(Continued)

Table 3.–(continued).

HTs: ..... PIPU/SECA			PIPU/EREX		PIPU/CAFO		PIPU/FEAR		PIPU/POPR	
No. plots: ..... (4)			(12)		(6)		(8)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Graminoids										
Agropyron arizonicum			< 1	17						
Agropyron (smithii?)					< 1	17				
Agrostis alba										
Andropogon spp.										
Andropogon cirratus										
Andropogon gerardi										
Andropogon scoparius										
Aristida spp.										
Aristida arizonica										
Aristida fendleriana										
Blepharoneuron tricholepis					< 1	17				
Bouteloua curtipendula										
Bouteloua gracilis										
Bromus anomalous					< 1	17	< 1	13		
Bromus carinatus										
Bromus ciliatus	2	100	5	100	< 1	50	3	75	6	100
Bromus frondosus										
Bromus lanatipes										
Bromus spp.					< 1	17	< 1	13		
Calamagrostis canadensis									20	100
Carex spp.			< 1	42			< 1	38	2	100
Carex foenea	5	75	3	75	10	100	5	88		
Carex lanuginosa									40	100
Carex microptera									5	100
Carex occidentalis			< 1	17						
Carex rossii	1	100	< 1	33	1	83	< 1	38		
Cyperus rusbyi										
Cyperus sp.										
Elymus glaucus										
Festuca arizonica			< 1	17	2	83	9	75		
Festuca sororia										
Glyceria elata			< 1	8					< 1	100
Glyceria striata									< 1	100
Koeleria nitida	< 1	50	1	83	< 1	67	< 1	100		

(Continued)

Table 3.--(continued).

HTs: ..... No. plots:	PIPU/SECA (4)		PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Luzula parviflora										
Lycurus phleoides										
Melica porteri			<1	8						
Muhlenbergia longiligula										
Muhlenbergia montana			<1	8	<1	17	3	63		
Muhlenbergia monticola										
Muhlenbergia pauciflora										
Muhlenbergia rigens										
Muhlenbergia virescens	<1	25	<1	25	<1	67	1	38		
Muhlenbergia wrightii										
Panicum bulbosum										
Piptochaetium fimbriatum										
Poa compressa										
Poa fendleriana	1	100	1	75	1	50	6	75		
Poa nervosa var tracyi										
Poa pratensis	<1	25	<1	17					25	100
Sitanion hystrix	<1	25	<1	25	<1	17	<1	63		
Sporobolus cryptandrus										
Stipa spp.										
Stipa pringlei			<1	8						
Trisetum montanum	<1	50	<1	17			<1	13		
Forbs										
Achillea millefolium	<1	75	4	92	<1	50	2	88	<1	100
Actaea rubra ssp. arguta			<1	8						
Agrimonia striata										
Allium cernuum			<1	17						
Allium kunthii										
Allium rhizomatum										
Antennaria marginata			<1	25			<1	25		
Antennaria parvifolia			<1	25	<1	17	<1	38		
Antennaria spp.					<1	33				
Aquilegia chrysantha										
Aquilegia elegantula	<1	50	<1	8	<1	17				
Aquilegia triternata	<1	25	<1	25	<1	17				
Arabis spp.					<1	17				

(Continued)

Table 3.–(continued).

HTs: ..... PIPU/SECA (4)			PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
No. plots:	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Arenaria lanuginosa			<1	25			<1	13		
Arenaria spp.					<1	67	<1	38		
Artemisia carruthii										
Artemisia dracunculoides										
Artemisia franserioides			2	50			<1	38		
Artemisia frigida										
Artemisia ludoviciana			<1	17			<1	38		
Asclepias spp.										
Aster falcatus										
Astragalus egglestonii										
Astragalus gilensis										
Astragalus humistratus										
Astragalus spp.										
Bahia dissecta										
Brickellia brachyphylla										
Brickellia fendleri			<1	8						
Brickellia grandiflora										
Brickellia spp.										
Calypso bulbosa										
Campanula rotundifolia			<1	58	<1	50	<1	38		
Cardamine cordifolia			<1	8						
Castilleja spp.	<1	50	<1	42			<1	25		
Chaptalia alsophila			<1	33			<1	13		
Chamerion angustifolium			<1	8						
Cicuta douglasii									2	100
Circaea alpina			<1	8					3	100
Cirsium spp.			<1	17	<1	33	<1	38		
Cirsium parryi			<1	33					<1	100
Cirsium wheeleri										
Clematis ligusticifolia			<1	8			<1	13		
Clematis pseudoalpina	<1	75	<1	42			<1	25		
Cologania longifolia										
Commelina dianthifolia										
Corallorhiza spp.										
Corallorhiza maculata			<1	8	<1	17				

(Continued)

Table 3.--(continued).

HTs: / No. plots:	PIPU/SECA (4)		PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Cryptantha jamesii										
Cucurbita foetidissima										
Cystopteris fragilis	<1	50	<1	58			<1	13		
Delphinium tenuisectum										
Desmanthus cooleyi										
Disporum trachycarpum	<1	25								
Draba helleriana			<1	42			<1	25		
Dugaldia hoopesii	<1	25	1	50	<1	17	<1	13	2	100
Equisetum arvense										
Equisetum laevigatum										
Erigeron concinnus										
Erigeron delphinifolius										
Erigeron divergens										
Erigeron eximius	<1	50	12	75	<1	83	<1	63		
Erigeron flagellaris							<1	13		
Erigeron formosissimus			1	17			<1	38		
Erigeron platyphyllus							<1	13		
Eriogonum alatum										
Eriogonum jamesii										
Erysimum capitatum										
Fragaria americana	6	100	5	83	3	17	<1	25		
Fragaria ovalis	<1	75	2	83	1	83	3	75	<1	100
Galium spp.										
Galium fendleri			<1	8						
Galium mexicanum										
Gaura hexandra										
Gentianella amarella s. acuta			<1	33						
Geranium caespitosum			<1	8	<1	17				
Geranium richarsonii	<1	100	5	75	<1	50	2	50	1	100
Geranium spp.			<1	8	<1	17	2	13		
Geum aleppicum ssp. strictum			<1	8					15	100
Gnaphalium macounii										
Goodyera oblongifolia	<1	25	<1	8			<1	13		
Goodyera repens			<1	17						
Halenia recurva			<1	17						

(Continued)

Table 3.–(continued).

HTs: ..... No. plots:	PIPU/SECA (4)		PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Haplopappus parryi	<1	25	<1	50	<1	50	<1	50		
Hedeoma oblongifolium										
Hedyotis pygmea										
Helianthella parryi										
Heterotheca fulcrata										
Hieracium fendleri			<1	42						
Hydrophyllum fendleri										
Hymenopappus filifolius										
Hymenopappus mexicanus										
Hypericum formosum			<1	8					4	100
Ipomopsis aggregata			<1	8	<1	17				
Iris missouriensis			<1	17					1	100
Kuhnia chlorolepis										
Lactuca graminifolia										
Lathyrus arizonicus	5	100	1	58	5	83	4	63		
Lathyrus graminifolius							<1	13		
Leucelene ericoides										
Ligusticum porteri			<1	25						
Linum lewisii										
Lithospermum multiflorum	<1	50	<1	25	<1	17	<1	50		
Lobelia anatina										
Lotus wrightii										
Lupinus neomexicanus										
Lupinus spp.					<1	17	<1	13		
Malaxis ehrenbergii										
Malaxis soulei										
Mertensia franciscana			<1	25						
Monarda menthaefolia										
Opuntia spp. (prickly pears)										
Osmorhiza depauperata	<1	25	<1	42						
Oxalis metcalfei	<1	25	<1	58			<1	13		
Oxybaphus linearis										
Oxypolis fendleri			<1	8					2	100
Oxytropis lambertii										
Pedicularis angustifolia			<1	17						

(Continued)

Table 3.–(continued).

HTs: ..... No. plots:	PIPU/SECA (4)		PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Pedicularis grayii	<1	50								
Pedicularis racemosa										
Penstemon barbatus	<1	50	<1	25			<1	63		
Penstemon linarioides										
Penstemom oliganthus										
Penstemon pinifolius										
Penstemon whippleanus										
Petalostemom candidum										
Polygonum sawatchensis										
Potentilla crinita							<1	13		
Potentilla gracilis v pulcher			<1	17	<1	33	<1	38		
Potentilla hippiana			<1	25			<1	13		
Potentilla spp.			<1	8						
Potentilla thurberi	<1	25	<1	42						
Prunella vulgaris			<1	33						
Pseudocymopteris montanus	<1	25	2	75	<1	67	<1	38		
Pseudostellaria jamesiana										
Psoralea tenuiflora										
Pteridium aquilinum	<1	50	<1	42	<1	17	1	25		
Pterospora andromeda			<1	8						
Pyrola chlorantha	<1	25			<1	17				
Pyrola picta										
Ramischia secunda	<1	50	<1	8						
Ratibida columnaris										
Rudbeckia laciniata									6	100
Rumex acetosella			<1	8					<1	100
Rumex crispus										
Rumex occidentalis									<1	100
Senecio actinella										
Senecio bigelovii			3	50			<1	13		
Senecio cardamine	9	100					<1	13		
Senecio cynthioides			<1	8						
Senecio eremophilus	<1	25	<1	17						
Senecio neomexicanus			<1	33	<1	83	<1	88		
Senecio quaerens			<1	17						

(Continued)

Table 3.–(continued).

HTs: / No. plots:	PIPU/SECA (4)		PIPU/EREX (12)		PIPU/CAFO (6)		PIPU/FEAR (8)		PIPU/POPR (1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Senecio wootoni	2	100	1	58	3	83	2	63		
Sidalcea neomexicana									4	100
Silene laciniata	<1	50			<1	17				
Silene scouleri	<1	25	<1	25						
Sisymbrium linearifolium										
Smilacina racemosa	<1	75	<1	58	<1	17	<1	25		
Smilacina stellata	<1	25	<1	25	<1	67	1	50	1	100
Solidago spathulata var neomex										
Solidago spp.			<1	8			<1	38		
Solidago wrightii										
Sphaeralcea coccinea										
Swertia radiata			<1	33	<1	17	<1	13		
Taraxacum spp.			<1	17	<1	33	<1	25		
Thalictrum fendleri	2	75	<1	67	<1	67	2	63		
Thermopsis pinetorum	15	75	<1	17						
Townsendia formosa			<1	25	<1	33	<1	38		
Tragia stylaris										
Valeriana capitata			2	33	<1	17	2	38		
Valeriana edulis			<1	33						
Veratrum californicum			<1	8						
Verbascum thapsus										
Vicia americana			<1	42	<1	83	<1	75	1	100
Vicia leucophaea										
Vicia pulchella										
Viguiera multiflora										
Viola canadensis	2	100	1	100	<1	50	<1	38		
Viola nephrophylla			<1	8					<1	100
Zygadenus elegans			<1	25						
Zygadenus virescens										

Table 4.--Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Abies concolor series.

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees																								
Abies concolor - Young regen.	>100	100	30	100	20	100	25	92	33	100	16	95	7	75	23	50	37	100	24	100	40	100	55	100
Abies concolor - Advance regen.	7	100	12	100	5	67	10	85	9	100	5	95	4	75	19	50	10	75	16	100	4	100	1	100
Abies concolor - Mature	3	100	3	80	1	67	5	92	1	60	2	63	<1	13	3	50	1	75	2	100	2	100	1	100
Abies lasiocarpa - Young regen.			<1	25			<1	8																
Abies lasiocarpa - Advance regen.			<1	10			<1	8																
Abies lasiocarpa - Mature																								
Alnus oblongifolia - Young regen.																								
Alnus oblongifolia - Advance regen.																								
Alnus oblongifolia - Mature																								
Juniperus deppeana - Young regen.																							1	100
Juniperus deppeana - Advance regen.																								
Juniperus deppeana - Mature											<1	5												
Juniperus osteosperma - Young regen.																								
Juniperus osteosperma - Advance regen.																								
Juniperus osteosperma - Mature																								
Juniperus scopulorum - Young regen.							<1	8																
Juniperus scopulorum - Advance regen.																								
Juniperus scopulorum- Mature																								
Picea engelmannii - Young regen.			2	15			<1	8							<1	50			<1	33				
Picea engelmannii - Advance regen.	<1	10	<1	20											<1	50								
Picea engelmannii - Mature	<1	10													<1	50								
Picea pungens - Young regen.							<1	15	<1	20	<1	11					<1	25	1	100				
Picea pungens - Advance regen.							<1	8	<1	20	<1	16							<1	33				
Picea pungens - Mature							<1	8																
Pinus edulis - Young regen.											<1	11	<1	13									1	100
Pinus edulis - Advance regen.																								
Pinus edulis - Mature																								
Pinus ponderosa - Young regen.	1	20	<1	30	<1	33	<1	23	2	60	1	42	4	63	2	50	1	50	<1	33				
Pinus ponderosa - Advance regen.			<1	30	3	67	<1	23	3	20	2	42	4	63			3	100					2	100
Pinus ponderosa - Mature	<1	10	1	55	<1	33	<1	8	2	100	1	53	4	88	<1	50	1	25	<1	67			4	100
Pinus strobiformis - Young regen.	7	100	6	85	8	100	6	100	4	100	3	63	5	88	<1	50	3	75	4	100				
Pinus strobiformis - Advance regen.	2	70	2	80	<1	33	2	62	2	80	2	63	2	75	<1	50	4	75	<1	33				
Pinus strobiformis - Mature	<1	50	<1	50			1	46	<1	40	1	58	<1	50					<1	33				
Populus angustifolia - Young regen.																								
Populus angustifolia - Advance regen.																								
Populus angustifolia - Mature																								
Populus tremuloides - Young regen.																								
Populus tremuloides - Advance regen.	5	70	<1	20	6	67	1	46	<1	20			<1	13					<1	33				
Populus tremuloides - Mature	3	60	<1	15			<1	15	1	40	<1	5			2	50	4	50						
Pseudotsuga menziesii - Young regen.	32	100	29	95	11	100	21	100	23	100	20	100	9	75	2	50	18	100	17	100	25	100	1	100
Pseudotsuga menziesii - Advance regen.	5	90	7	100	4	67	10	92	8	80	10	95	6	100	6	50	11	100	5	100	3	100	7	100
Pseudotsuga menziesii - Mature	6	100	4	100	4	100	3	77	4	100	2	79	<1	38	1	50	2	50	3	100	1	100		

(Continued)

Table 4.--(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Shrubs																								
Acer glabrum	11	60	<1	25			8	100			<1	5												
Acer grandidentatum																					18	100		
Acer negundo																					5	100	10	100
Alnus oblongifolia																								
Berberis repens			<1	15			<1	8			<1	5												
Calliandra humilis																								
Ceanothus fendleri			<1	5							<1	5	<1	38										
Cercocarpus montanus											<1	5	<1	13										
Chimaphila umbellata	<1	10	<1	35			<1	23	<1	20	<1	16							<1	33				
Cornus stolonifera																								
Fraxinus pennsylvanica																							1	100
Garrya wrightii																								
Gutierrezia sarothrae																								
Holodiscus dumosus	<1	10	<1	5	2	67	1	62			<1	21	<1	13			1	50						
Hymenoxys richardsonii																								
Jamesia americana					6	100	<1	23																
Juglans major																							30	100
Juniperus communis					<1	67																		
Lonicera albiflora											<1	5												
Lonicera arizonica	<1	10	<1	35	1	33	2	54			<1	37							<1	67	<1	100	<1	100
Nolina microcarpa																								
Parthenocissus vitacea																								
Philadelphus spp.											<1	5	<1	13										
Physocarpus monogynus			<1	20			<1	54			<1	11									<1	100		
Populus tremuloides - shrubs	2	70	<1	45	<1	67	<1	15	<1	60	<1	16	<1	13			<1	50	<1	67				
Ptelea trifoliata											<1	5											<1	100
Prunus emarginata							<1	8					<1	13										
Prunus virginiana																					<1	100		
Quercus chrysolepis																								
Quercus emoryi																								
Quercus gambelii	<1	30	<1	30			<1	23	1	100	29	100	17	100					<1	67	<1	100	30	100
Quercus grisea																								
Quercus hypoleucoides											<1	5	<1	13										
Quercus rugosa											<1	5	<1	13										
Rhamnus betulaefolia													<1	13							5	100		
Rhus glabra																								
Rhus trilobata																								
Ribes cereum																								
Ribes montigenum																								
Ribes pinetorum	<1	40			<1	33	<1	23					<1	13	1	50	<1	25						
Ribes wolfii																								
Robinia neomexicana	<1	10	<1	65			<1	46	<1	20	4	58	4	75	30	50			<1	100				

(Continued)

Table 4.--(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Rosa spp.	<1	20	<1	15			<1	23	<1	40	<1	37	<1	50					<1	67			<1	100
Rubus arizonensis																								
Rubus parviflorus	<1	10	<1	30			<1	15	<1	20	<1	5							<1	67				
Rubus strigosus	<1	10											<1	13	5	50								
Salix bebbiana																								
Salix scouleriana	<1	10	<1	15	2	67	<1	23			<1	5							<1	67				
Salix spp.																								
Sambucus spp.			<1	10			<1	15													<1	100		
Shepherdia canadensis																								
Sorbus dumosa																								
Symphoricarpus oreophilus	<1	10	<1	60			5	62	<1	20	3	42	<1	13					<1	67	1	100		
Toxicodendron rydbergii													<1	13									5	100
Vaccinium myrtillus			<1	15																				
Vitis arizonica																							7	100
Yucca baccata											<1	5												
Yucca schottii																								
Graminoids																								
Agropyron arizonicum	3	70	<1	5							<1	11												
Agropyron (smithii?)											<1	5	<1	13										
Agrostis alba																								
Andropogon spp.																								
Andropogon cirratus																								
Andropogon gerardi																								
Andropogon scoparius																								
Aristida spp.																								
Aristida arizonica																								
Aristida fendleriana																								
Blepharoneuron tricholepis													<1	25			<1	50	<1	33				
Bouteloua curtipendula																								
Bouteloua gracilis																								
Bromus anomalous																								
Bromus carinatus																								
Bromus ciliatus	29	100	<1	80	3	100	4	85	1	60	5	100	1	88	15	50	4	100	2	100	10	100	15	100
Bromus frondosus																								
Bromus lanatipes																								
Bromus spp.			<1	5			<1	8	1	40														
Calamagrostis canadensis																								
Carex spp.	<1	50	<1	20	<1	33	<1	8	<1	60	<1	37	<1	38			<1	50			3	100	<1	100
Carex foenea	13	70					<1	15	<1	20	<1	5	<1	13	25	50	<1	50	<1	67				
Carex lanuginosa																								
Carex microptera																								
Carex occidentalis							<1	15											<1	33			<1	100

(Continued)

Table 4.–(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Carex rossii	<1	10	<1	40			<1	38	<1	40	<1	37	<1	63	1	50	<1	25	1	67				
Cyperus rusbyi																								
Cyperus sp.																								
Elymus glaucus							<1	8															<1	100
Festuca arizonica			<1	5	1	67					<1	5					9	100						
Festuca sororia	2	40																						
Glyceria elata																								
Glyceria striata																								
Koeleria nitida	<1	40	<1	35	2	100	<1	38	<1	60	1	74	<1	75	<1	50	3	75	<1	33				
Luzula parviflora																								
Lycurus phleoides																								
Melica porteri																								
Muhlenbergia longiligula																								
Muhlenbergia montana					<1	33					<1	16	<1	13			6	75						
Muhlenbergia monticola																								
Muhlenbergia pauciflora																							<1	100
Muhlenbergia rigens											<1	5												
Muhlenbergia virescens	<1	10	<1	25			<1	8	5	100	<1	42	14	100					<1	33				
Muhlenbergia wrightii																								
Panicum bulbosum																								
Piptochaetium fimbriatum																								
Poa compressa																								
Poa fendleriana	<1	50	<1	35	<1	33	<1	62	<1	100	3	100	<1	75	<1	50	4	50	12	100	<1	100	<1	100
Poa nervosa var tracyi																								
Poa pratensis															2	50	<1	25						
Sitanion hystrix	<1	10	<1	30	<1	67	<1	8	1	60	<1	42	<1	75			<1	75	<1	33				
Sporobolus cryptandrus																								
Stipa spp.																								
Stipa pringlei																								
Trisetum montanum	<1	40	<1	5			<1	8											<1	33				
Forbs																								
Achillea millefolium	2	80	<1	20	<1	67	<1	23	<1	80	2	68	1	75			<1	75	<1	67				
Actaea rubra ssp. arguta							<1	8							<1	50								
Agrimonia striata																	<1	25						
Allium cernuum					<1	100	<1	8			<1	11					<1	50						
Allium kunthii																								
Allium rhizomatum																								
Antennaria marginata			<1	5	<1	33	<1	8			<1	21					2	50						
Antennaria parvifolia	<1	20			<1	33	<1	8			<1	16	<1	13										
Antennaria spp.			<1	10							<1	16	<1	25			<1	25						
Aquilegia chrysantha	<1	10					<1	8																
Aquilegia elegantula	<1	10	<1	5																				
Aquilegia triternata	<1	20	<1	5																				

(Continued)

Table 4.–(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Arabis spp.											<1	5												
Arenaria lanuginosa	<1	10	<1	5							<1	5												
Arenaria spp.											<1	5												
Artemisia carruthii											<1	11	<1	13										
Artemisia dracunculoides									<1	20	<1	11	<1	13										
Artemisia franserioides	2	70	<1	5	<1	33	<1	46			<1	16					<1	25	<1	100				
Artemisia frigida																								
Artemisia ludoviciana	<1	20							<1	20	<1	26	<1	38			<1	25	<1	33				
Asclepias spp.																								
Aster falcatus																								
Astragalus egglestonii																								
Astragalus gilensis																								
Astragalus humistratus			<1	5							<1	5	<1	13										
Astragalus spp.																								
Bahia dissecta																								
Brickellia brachyphylla																								
Brickellia fendleri							<1	8																
Brickellia grandiflora													<1	13										
Brickellia spp.	<1	10					<1	23			<1	11	<1	25							<1	100	<1	100
Calypso bulbosa																								
Campanula rotundifolia	<1	10	<1	10							<1	11			<1	50	<1	75						
Cardamine cordifolia																								
Castilleja spp.	<1	20	<1	5	<1	33	<1	8			<1	26	<1	13			<1	50						
Chaptalia alsophila													<1	13			<1	25						
Chamerion angustifolium															<1	50								
Cicuta douglasii																								
Circaea alpina																								
Cirsium spp.			<1	5					<1	60	<1	16	<1	75			<1	50						
Cirsium parryi	<1	20																						
Cirsium wheeleri																								
Clematis ligusticifolia																							<1	100
Clematis pseudoalpina	<1	20	<1	40	<1	33	<1	62			<1	26	<1	13			<1	25						
Cologania longifolia																								
Commelina dianthifolia													<1	13										
Corallorhiza spp.			<1	10																				
Corallorhiza maculata			<1	30					<1	20	<1	16	<1	13										
Cryptantha jamesii																								
Cucurbita foetidissima																								
Cystopteris fragilis	<1	20			<1	33	<1	15			<1	11					<1	50						
Delphinium tenuisectum																								
Desmanthus cooleyi																								
Disporum trachycarpum	<1	30					<1	8																
Draba helleriana	<1	20	<1	5	<1	33	<1	23			<1	16					<1	50	<1	33				

(Continued)

Table 4.–(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Dugaldia hoopesii	2	50	<1	15					<1	40	<1	5	<1	13					<1	33				
Equisetum arvense																								
Equisetum laevigatum																								
Erigeron concinnus																								
Erigeron delphinifolius									<1	20	<1	11	<1	25										
Erigeron divergens																								
Erigeron eximius	10	70	<1	5	<1	33	<1	38			<1	32			<1	50			<1	67				
Erigeron flagellaris											<1	11												
Erigeron formosissimus	<1	10									<1	11					4	25						
Erigeron platyphyllus			<1	15	<1	33			<1	60	<1	16	<1	38										
Eriogonum alatum													<1	13										
Eriogonum jamesii													<1	13										
Erysimum capitatum											<1	5	<1	13										
Fragaria americana	<1	40	<1	20			1	62	<1	20	<1	37	<1	25	1	50			3	100	5	100		
Fragaria ovalis	1	80	<1	45	<1	33	<1	23	<1	80	<1	53	<1	75	1	50	<1	50	<1	67			<1	100
Galium spp.					<1	33	<1	15					<1	13			<1	50						
Galium fendleri					<1	33	<1	23	<1	20	<1	16	<1	25					<1	33				
Galium mexicanum													<1	13									3	100
Gaura hexandra																								
Gentianella amarella s. acuta	<1	10					<1	8									<1	25						
Geranium caespitosum	<1	10	<1	5					<1	40	<1	42	<1	100										
Geranium richarsonii	5	100	<1	45			<1	38	<1	20	<1	26	<1	13	<1	50	<1	50	<1	33	<1	100		
Geranium spp.											<1	5							<1	33			<1	100
Geum aleppicum ssp. strictum																								
Gnaphalium macounii																								
Goodyera oblongifolia	<1	20	<1	50			<1	8	<1	40	<1	5												
Goodyera repens	<1	10	<1	5			<1	8			<1	5												
Halenia recurva																								
Haplopappus parryi	<1	80	<1	60	<1	67	<1	54	<1	100	<1	32	<1	50	<1	50	<1	100	<1	67				
Hedeoma oblongifolium																								
Hedyotis pygmea																								
Helianthella parryi																								
Heterotheca fulcrata			<1	5																				
Hieracium fendleri	<1	10	<1	10			<1	8	<1	40	<1	11	<1	38							<1	100		
Hydrophyllum fendleri																								
Hymenopappus filifolius																								
Hymenopappus mexicanus																								
Hypericum formosum																								
Ipomopsis aggregata											<1	16	<1	13										
Iris missouriensis											<1	11					<1	25						
Kuhnia chlorolepis																								
Lactuca graminifolia																								
Lathyrus arizonicus	4	80	<1	55			<1	46	2	80	2	63	<1	75			<1	50	2	100				

(Continued)

Table 4.--(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Lathyrus graminifolius									<1	20	<1	21	<1	13										
Leucelene ericoides																								
Ligusticum porteri	<1	60																						
Linum lewisii											<1	5												
Lithospermum multiflorum			<1	35			<1	15	<1	80	<1	53	<1	75	<1	50	<1	25	<1	33				
Lobelia anatina																								
Lotus wrightii													<1	13										
Lupinus neomexicanus																								
Lupinus spp.			<1	5													<1	25	<1	33				
Malaxis ehrenbergii																								
Malaxis soulei											<1	11	<1	13										
Mertensia franciscana	<1	10	<1	5									<1	13										
Monarda menthaefolia	<1	10																			<1	100	1	100
Opuntia spp. (prickly pears)																								
Osmorhiza depauperata	<1	70	<1	10																				
Oxalis metcalfei	<1	60	<1	10	<1	33	<1	23			<1	16	<1	25			<1	50			1	100		
Oxybaphus linearis											<1	5												
Oxypolis fendleri																								
Oxytropis lambertii			<1	5									<1	13										
Pedicularis angustifolia			<1	5															<1	33				
Pedicularis grayii	<1	30					<1	8											<1	33				
Pedicularis racemosa																								
Penstemon barbatus	<1	20	<1	25	<1	67	<1	31	<1	60	<1	74	<1	75	<1	50			<1	67	<1	100		
Penstemon linarioides																								
Penstemom oliganthus					<1	33					<1	5					<1	50						
Penstemon pinifolius											<1	5	<1	13										
Penstemon whippleanus																								
Petalostemom candidum																								
Polygonum sawatchensis																								
Potentilla crinita																								
Potentilla gracilis v pulcher											<1	5	<1	25			<1	25	<1	33				
Potentilla hippiana																			<1	33				
Potentilla spp.																			<1	33	<1	100		
Potentilla thurberi											<1	11									<1	100		
Prunella vulgaris	<1	10																						
Pseudocymopteris montanus	<1	60	<1	40	<1	33	<1	54	<1	80	<1	42	<1	63	<1	50	2	75	<1	67	<1	100		
Pseudostellaria jamesiana																							3	100
Psoralea tenuiflora																								
Pteridium aquilinum	2	60	<1	60					2	80	<1	11	1	50	3	50			<1	33	<1	100		
Pterospora andromeda							<1	8			<1	5	<1	13										
Pyrola chlorantha	<1	50	<1	15			<1	8	<1	20									<1	33				
Pyrola picta			<1	25			<1	23					<1	13										

(Continued)

Table 4.–(continued).

HTs:	ABCO/ EREX		ABCO/ Sparse		ABCO/ HODU		ABCO/ ACGL		ABCO/ MUVI		ABCO/ QUGA Typic ph.		ABCO/ QUGA MUVI ph.		ABCO/ RONE		ABCO/ FEAR Typic ph.		ABCO/ FEAR POFE ph.		ABCO/ ACGR		ABCO/ JUMA	
No. plots:	(10)		(20)		(3)		(13)		(5)		(19)		(8)		(2)		(4)		(3)		(1)		(1)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Ramischia secunda	<1	20	<1	20			<1	15																
Ratibida columnaris																								
Rudbeckia laciniata																								
Rumex acetosella																								
Rumex crispus																								
Rumex occidentalis																								
Senecio actinella																								
Senecio bigelovii	<1	50																						
Senecio cardamine			<1	15			<1	8																
Senecio cynthioides					<1	67	<1	8			<1	5					<1	25						
Senecio eremophilus	<1	20	<1	5									<1	13										
Senecio neomexicanus	<1	30	<1	15			<1	8	<1	100	<1	32	<1	75			<1	25	<1	67	<1	100		
Senecio quaerens																							<1	100
Senecio wootoni	<1	40	<1	45	<1	33	<1	38	1	80	<1	47	<1	63	<1	50	<1	50	1	100				
Sidalcea neomexicana																	<1	25						
Silene laciniata											<1	11	<1	13					<1	33				
Silene scouleri	<1	20			<1	33	<1	15			<1	16					<1	25						
Sisymbrium linearifolium									<1	20			<1	25										
Smilacina racemosa	<1	20	<1	45			<1	85	<1	20	<1	32	<1	38					<1	67	<1	100	<1	100
Smilacina stellata	4	90	<1	30	<1	33	<1	46	<1	20	<1	21	<1	25	<1	50			<1	33				
Solidago spathulata var neomex																								
Solidago spp.					<1	33	<1	8	<1	20	<1	5	<1	25										
Solidago wrightii											<1	5	<1	13										
Sphaeralcea coccinea																								
Swertia radiata	<1	30															<1	25						
Taraxacum spp.																	<1	25						
Thalictrum fendleri	4	90	<1	45			<1	69	<1	60	1	58	<1	38	10	50	<1	25	<1	100	<1	100	2	100
Thermopsis pinetorum	<1	10	<1	10			<1	8	4	40	<1	21	<1	25										
Townsendia formosa											<1	5					<1	50	<1	33				
Tragia stylaris																								
Valeriana capitata	<1	10					<1	31											<1	33				
Valeriana edulis																								
Veratrum californicum																								
Verbascum thapsus															<1	50								
Vicia americana	2	80	<1	10			<1	31	<1	40	<1	68	<1	38			1	25						
Vicia leucophaea									<1	20														
Vicia pulchella							<1	8	<1	40	<1	11	<1	75			<1	25	<1	33				
Viguiera multiflora													<1	13										
Viola canadensis	3	90	<1	35			<1	69	<1	80	<1	21			<1	50	<1	25	<1	67	5	100	2	100
Viola nephrophylla																								
Zygadenus elegans	<1	10	<1	5	<1	33	<1	15			<1	5												
Zygadenus virescens			<1	5																				

Table 5.–Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Pseudotsuga menziesii series.

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees																				
Abies concolor - Young regen.					<1	11	<1	13	<1	11	<1	10			1	22			<1	29
Abies concolor - Advance regen.					<1	11			<1	4	<1	30			<1	33	<1	14		
Abies concolor - Mature															<1	22	<1	14		
Abies lasiocarpa - Young regen.																				
Abies lasiocarpa - Advance regen.																				
Abies lasiocarpa - Mature																				
Alnus oblongifolia - Young regen.																				
Alnus oblongifolia - Advance regen.																				
Alnus oblongifolia - Mature																				
Juniperus deppeana - Young regen.									<1	11	<1	10			<1	11	2	29		
Juniperus deppeana - Advance regen.									<1	7							<1	29		
Juniperus deppeana - Mature																	<1	29		
Juniperus osteosperma - Young regen.																				
Juniperus osteosperma - Advance regen.																				
Juniperus osteosperma - Mature																				
Juniperus scopulorum - Young regen.									<1	15							<1	14		
Juniperus scopulorum - Advance regen.									<1	7							<1	14		
Juniperus scopulorum- Mature																				
Picea engelmannii - Young regen.					<1	11	<1	13												
Picea engelmannii - Advance regen.					<1	11	<1	13												
Picea engelmannii - Mature																				
Picea pungens - Young regen.									<1	4	<1	10			<1	22				
Picea pungens - Advance regen.																				
Picea pungens - Mature																				
Pinus edulis - Young regen.					<1	22			<1	26			4	50	<1	22	<1	57	1	43
Pinus edulis - Advance regen.									<1	4			<1	50			<1	14	<1	29
Pinus edulis - Mature																				
Pinus ponderosa - Young regen.					4	56			3	59	8	80	4	100	5	78	2	57	4	57
Pinus ponderosa - Advance regen.	2	50			2	44			5	74	10	90	2	50	4	78	7	86	3	86
Pinus ponderosa - Mature					3	78	<1	13	2	70	5	100	2	100	5	100	2	71	4	86
Pinus strobiformis - Young regen.	29	100	1	100	5	67	6	100	4	56	3	70	1	100	6	67	5	57	1	29
Pinus strobiformis - Advance regen.	6	100			3	78	2	75	1	48	2	50			3	67	1	43	<1	29
Pinus strobiformis - Mature	2	100	2	100	1	44	2	75	<1	22	<1	20			<1	22	<1	14		
Populus angustifolia - Young regen.																				
Populus angustifolia - Advance regen.																				
Populus angustifolia - Mature																				
Populus tremuloides - Young regen.																				
Populus tremuloides - Advance regen.	8	100	3	100	1	22	<1	38			<1	10								
Populus tremuloides - Mature					<1	22					<1	10			<1	11				
Pseudotsuga menziesii - Young regen.	16	100	3	100	21	100	30	100	26	100	12	100	5	100	43	100	6	71	3	100
Pseudotsuga menziesii - Advance regen.	4	100			7	89	8	88	12	100	6	80	1	50	13	89	3	71	3	86
Pseudotsuga menziesii - Mature	3	100	6	100	3	67	9	100	3	81	<1	20	1	50	1	56	4	71	1	43

(Continued)

Table 5.–(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Shrubs																				
Acer glabrum							1	38												
Acer grandidentatum									1	7										
Acer negundo																				
Alnus oblongifolia																				
Berberis repens									<1	26	<1	10								
Calliandra humilis																				
Ceanothus fendleri					<1	11			<1	7	<1	40			<1	56	<1	14	<1	43
Cercocarpus montanus									<1	7			<1	50			<1	29	1	71
Chimaphila umbellata															<1	11			<1	29
Cornus stolonifera																				
Fraxinus pennsylvanica									<1	7									<1	14
Garrya wrightii									<1	4									<1	14
Gutierrezia sarothrae													<1	50						
Holodiscus dumosus	<1	50	5	100	<1	33	1	63	<1	7					<1	11	<1	29		
Hymenoxys richardsonii																	<1	14		
Jamesia americana							<1	25												
Juglans major																				
Juniperus communis	1	100																		
Lonicera albiflora																	<1	14		
Lonicera arizonica	<1	50							<1	33										
Nolina microcarpa																			<1	14
Parthenocissus vitacea																				
Philadelphus spp.									<1	4							<1	14		
Physocarpus monogynus							<1	13												
Populus tremuloides - shrubs	<1	100			<1	22	<1	63			<1	30			<1	22				
Ptelea trifoliata									<1	4										
Prunus emarginata									<1	4	<1	20								
Prunus virginiana									<1	4	<1	10								
Quercus chrysolepis									<1	4										
Quercus emoryi																				
Quercus gambelii					<1	33			30	100	23	100	25	100	<1	33	2	57	4	43
Quercus grisea					<1	11							3	50	<1	11	1	14	1	29
Quercus hypoleucoides											<1	10					<1	14	18	86
Quercus rugosa											<1	10							18	100
Rhamnus betulaefolia																				
Rhus glabra																				
Rhus trilobata																	<1	14		
Ribes cereum					<1	22	<1	25												
Ribes montigenum																				
Ribes pinetorum					<1	22	1	50												
Ribes wolfii																				

(Continued)

Table 5.–(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Robinia neomexicana			4	100			<1	13	<1	44	1	30			<1	22	<1	14	<1	43
Rosa spp.									<1	44	<1	30			<1	33	<1	14		
Rubus arizonensis																				
Rubus parviflorus																				
Rubus strigosus																				
Salix bebbiana																				
Salix scouleriana			2	100					<1	4										
Salix spp.																				
Sambucus spp.									<1	4							<1	14		
Shepherdia canadensis																				
Sorbus dumosa																				
Symphoricarpus oreophilus			6	100			<1	13	<1	15	<1	10			<1	11	<1	14		
Toxicodendron rydbergii									<1	4					<1	11				
Vaccinium myrtillus																				
Vitis arizonica																				
Yucca baccata									<1	4							<1	14	<1	14
Yucca schottii																				
Graminoids																				
Agropyron arizonicum									<1	7										
Agropyron (smithii?)																				
Agrostis alba																				
Andropogon spp.																	<1	14		
Andropogon cirratus																				
Andropogon gerardi																				
Andropogon scoparius																	<1	14		
Aristida spp.																				
Aristida arizonica																	<1	14		
Aristida fendleriana																				
Blepharoneuron tricholepis					<1	56	<1	38	<1	11	<1	10	3	100	<1	22	1	71	<1	29
Bouteloua curtipendula																				
Bouteloua gracilis																	<1	14		
Bromus anomalous					<1	11			<1	4	<1	10								
Bromus carinatus																				
Bromus ciliatus	<1	100	<1	100	2	56	27	100	1	59	<1	50			1	56	<1	29		
Bromus frondosus											<1	20			<1	11				
Bromus lanatipes																	<1	14	<1	14
Bromus spp.					<1	11			2	30	<1	40	<1	50	<1	44	1	29	<1	14
Calamagrostis canadensis																				
Carex spp.	<1	100			1	78	<1	75	<1	63	<1	50	1	100	<1	67	<1	57	<1	100
Carex foenea					<1	22	2	38			<1	10					<1	14		
Carex lanuginosa																				
Carex microptera																				

(Continued)

Table 5.–(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Aquilegia triternata									<1	7										
Arabis spp.									<1	15	<1	20					<1	14	<1	29
Arenaria lanuginosa							<1	25			<1	10					<1	14		
Arenaria spp.																				
Artemisia carruthii					<1	22			<1	30	<1	20					<1	43	<1	14
Artemisia dracunculoides					<1	11			<1	4										
Artemisia franserioides					<1	11	<1	38	<1	7	<1	10								
Artemisia frigida																				
Artemisia ludoviciana					<1	33	<1	38	<1	30	<1	50	<1	100	<1	22	<1	14	<1	14
Asclepias spp.																				
Aster falcatus																				
Astragalus egglestonii																				
Astragalus gilensis									<1	7							<1	14		
Astragalus humistratus											<1	20								
Astragalus spp.									<1	7										
Bahia dissecta					<1	11			<1	11	<1	20	<1	50	<1	22	<1	14		
Brickellia brachyphylla									<1	4										
Brickellia fendleri																				
Brickellia grandiflora									<1	15										
Brickellia spp.									<1	48					<1	22	<1	14	<1	57
Calypso bulbosa					<1	11														
Campanula rotundifolia					<1	11	<1	50	<1	7					<1	11	<1	14		
Cardamine cordifolia																				
Castilleja spp.					<1	11			<1	26	<1	10			<1	11				
Chaptalia alsophila					<1	11			<1	15	<1	10								
Chamerion angustifolium																				
Cicuta douglasii																				
Circaea alpina																				
Cirsium spp.					<1	33	<1	25	<1	11	<1	50			<1	44				
Cirsium parryi																				
Cirsium wheeleri																				
Clematis ligusticifolia									<1	4										
Clematis pseudoalpina	<1	100	<1	100			<1	25	<1	15	<1	10								
Cologania longifolia															<1	11				
Commelina dianthifolia									<1	7	<1	20	<1	50			<1	14		
Corallorhiza spp.									<1	4										
Corallorhiza maculata					<1	11	<1	13	<1	4							<1	14		
Cryptantha jamesii																				
Cucurbita foetidissima																				
Cystopteris fragilis							<1	25	<1	15			<1	50						
Delphinium tenuisectum																				
Desmanthus cooleyi																				
Disporum trachycarpum																				

(Continued)

Table 5.--(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Carex occidentalis									<1	4							<1	29		
Carex rossii					<1	11			<1	11	1	30			<1	22	1	29		
Cyperus rusbyi											<1	10								
Cyperus sp.																				
Elymus glaucus																				
Festuca arizonica					10	100	<1	50	<1	4	<1	10	5	100	<1	11				
Festuca sororia							<1	13												
Glyceria elata																				
Glyceria striata																				
Koeleria nitida	<1	100			1	89	<1	75	1	70	<1	40	2	100	<1	100	<1	71		
Luzula parviflora																				
Lycurus phleoides																				
Melica porteri																				
Muhlenbergia longiligula																			2	71
Muhlenbergia montana	2	100			5	89	1	25	<1	37	<1	20	2	100			8	100		
Muhlenbergia monticola																			<1	14
Muhlenbergia pauciflora																			<1	29
Muhlenbergia rigens																	<1	14		
Muhlenbergia virescens					<1	22			<1	15	15	100	<1	50	12	100	<1	29	<1	43
Muhlenbergia wrightii																				
Panicum bulbosum																				
Piptochaetium fimbriatum																				
Poa compressa																				
Poa fendleriana					<1	67	10	88	3	96	2	60	<1	100	<1	56	2	43	<1	57
Poa nervosa var tracyi																				
Poa pratensis					<1	11	<1	13												
Sitanion hystrix	<1	100			<1	67	<1	50	<1	44	1	40	1	100	<1	67	1	86		
Sporobolus cryptandrus																				
Stipa spp.																				
Stipa pringlei											<1	30			<1	11	<1	29		
Trisetum montanum							<1	38												
Forbs																				
Achillea millefolium	<1	50			<1	78	2	75	<1	63	1	60	<1	100	<1	78	<1	43	<1	14
Actaea rubra ssp. arguta																				
Agrimonia striata																				
Allium cernuum	<1	50			<1	22	<1	13	<1	22			<1	50			<1	29		
Allium kunthii																				
Allium rhizomatum																				
Antennaria marginata					<1	11			<1	44	<1	10	<1	50					<1	14
Antennaria parvifolia					<1	22	<1	25	<1	19	<1	10	<1	50	<1	22				
Antennaria spp.															<1	22				
Aquilegia chrysantha																				
Aquilegia elegantula																				

(Continued)

Table 5.–(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Draba helleriana					<1	33	<1	50	<1	33										
Dugaldia hoopesii							<1	25			<1	20								
Equisetum arvense																				
Equisetum laevigatum																				
Erigeron concinnus																				
Erigeron delphinifolius									<1	7	<1	10			<1	22			<1	57
Erigeron divergens															<1	11	<1	14		
Erigeron eximius							5	63			<1	10								
Erigeron flagellaris					<1	11			<1	4	<1	10	<1	100						
Erigeron formosissimus					<1	33	<1	13	<1	11			<1	100	<1	22	<1	14		
Erigeron platyphyllus	<1	50							<1	37	<1	40	<1	50	<1	56	<1	29		
Eriogonum alatum											<1	10			<1	11	<1	43		
Eriogonum jamesii									<1	11					<1	11	<1	14		
Erysimum capitatum					<1	22	<1	38	<1	7					<1	11				
Fragaria americana					<1	11	<1	25	<1	48										
Fragaria ovalis	<1	50			<1	22	<1	50	<1	7	<1	30			<1	11	<1	14		
Galium spp.					<1	22	<1	13	<1	26			<1	50	<1	11				
Galium fendleri									<1	19	<1	10			<1	22	<1	29		
Galium mexicanum																				
Gaura hexandra																				
Gentianella amarella s. acuta							<1	38												
Geranium caespitosum					<1	33			<1	44	<1	60	<1	50	<1	44	<1	29		
Geranium richarsonii					<1	11	<1	38	<1	11							<1	14		
Geranium spp.									<1	4					<1	11	<1	14	<1	14
Geum aleppicum ssp. strictum																				
Gnaphalium macounii					<1	11							<1	50	<1	11				
Goodyera oblongifolia					<1	11			<1	4										
Goodyera repens																				
Halenia recurva							<1	13												
Haplopappus parryi	<1	50	<1	100	<1	44	1	75	<1	48	<1	10			<1	33	<1	14	<1	14
Hedeoma oblongifolium									<1	4										
Hedyotis pygmea																	<1	14		
Helianthella parryi									<1	11	<1	10								
Heterotheca fulcrata													<1	50			<1	14		
Hieracium fendleri	<1	50			<1	33			<1	41	<1	60	<1	100	<1	78				
Hydrophyllum fendleri																				
Hymenopappus filifolius																				
Hymenopappus mexicanus															<1	11	<1	14		
Hypericum formosum																				
Ipomopsis aggregata	<1	50			<1	22			<1	37	<1	30	<1	100	<1	44	<1	29		
Iris missouriensis					<1	11	<1	50												
Kuhnia chlorolepis									<1	4					<1	11				
Lactuca graminifolia																				

(Continued)

Table 5.--(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Lathyrus arizonicus					<1	56	<1	63	<1	52	<1	50			<1	33	<1	14		
Lathyrus graminifolius					<1	11	<1	13	<1	15	<1	10	<1	50	<1	33	<1	14		
Leucelene ericoides																				
Ligusticum porteri							<1	13												
Linum lewisii					<1	22			<1	11	<1	10					<1	14		
Lithospermum multiflorum	<1	100			<1	33	<1	13	<1	74	<1	80			<1	89	<1	43	<1	14
Lobelia anatina																				
Lotus wrightii									<1	15							<1	14		
Lupinus neomexicanus																	<1	29		
Lupinus spp.									<1	4										
Malaxis ehrenbergii									<1	7					<1	11				
Malaxis soulei					<1	11			<1	4	<1	10			<1	22				
Mertensia franciscana					<1	11	<1	25												
Monarda menthaefolia																				
Opuntia spp. (prickly pears)																			<1	14
Osmorhiza depauperata					<1	11														
Oxalis metcalfei							<1	50	<1	19										
Oxybaphus linearis											<1	20								
Oxypolis fendleri																				
Oxytropis lambertii																				
Pedicularis angustifolia																				
Pedicularis grayii							<1	13												
Pedicularis racemosa																				
Penstemon barbatus					<1	22	<1	25	<1	70	<1	20			<1	78	<1	43	<1	14
Penstemon linarioides																				
Penstemom oliganthus	<1	50			<1	22	<1	13									<1	14		
Penstemon pinifolius	<1	50													<1	22	<1	29	<1	14
Penstemon whippleanus																				
Petalostemom candidum																				
Polygonum sawatchensis																				
Potentilla crinita																				
Potentilla gracilis v pulcher											<1	10								
Potentilla hippiana									<1	15					<1	22				
Potentilla spp.							<1	13	<1	11					<1	11				
Potentilla thurberi									<1	7	<1	20								
Prunella vulgaris																				
Pseudocymopteris montanus	<1	50			<1	67	<1	50	<1	52	<1	70	<1	100	<1	56	<1	29	<1	29
Pseudostellaria jamesiana																				
Psoralea tenuiflora																				
Pteridium aquilinum					<1	11	<1	25	<1	4	3	50			<1	33				
Pterospora andromeda									<1	4	<1	10								
Pyrola chlorantha					<1	11			<1	4										

(Continued)

Table 5.–(continued).

HTs:	PSME/ ARUV		PSME/ HODU		PSME/ FEAR		PSME/ BRCI		PSME/ QUGA Typic ph.		PSME/ QUGA MUVI ph.		PSME/ QUGA FEAR ph.		PSME/ MUVI		PSME/ MUMO		PSME/ QUHY	
No. plots:	(2)		(1)		(9)		(8)		(27)		(10)		(2)		(9)		(7)		(7)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Pyrola picta															<1	22				
Ramischia secunda							<1	13												
Ratibida columnaris																				
Rudbeckia laciniata																				
Rumex acetosella																				
Rumex crispus																				
Rumex occidentalis																				
Senecio actinella																	<1	14		
Senecio bigelovii							<1	13												
Senecio cardamine																				
Senecio cynthioides	<1	50			<1	44	<1	13	<1	15	<1	20	<1	50	<1	11	<1	14		
Senecio eremophilus									<1	4										
Senecio neomexicanus					<1	22	<1	13	<1	48	<1	30	<1	50	<1	78	<1	43	<1	29
Senecio quaerens																				
Senecio wootoni	<1	50			2	22	<1	13	<1	33	<1	50			<1	67	<1	29		
Sidalcea neomexicana																				
Silene laciniata													<1	100			<1	14		
Silene scouleri					<1	11	<1	13	<1	11	<1	10			<1	11				
Sisymbrium linearifolium					<1	33			<1	7	<1	20	<1	100	<1	22	<1	29	<1	14
Smilacina racemosa									<1	22										
Smilacina stellata	<1	50	<1	100			<1	25	<1	19	<1	20			<1	11				
Solidago spathulata var neomex	4	100																		
Solidago spp.									<1	33	<1	20	<1	100	<1	22	<1	14	<1	14
Solidago wrightii																	<1	29		
Sphaeralcea coccinea																				
Swertia radiata																				
Taraxacum spp.									<1	4										
Thalictrum fendleri					<1	22	<1	50	<1	63	<1	30			<1	22	<1	14		
Thermopsis pinetorum									<1	11	<1	10			<1	33				
Townsendia formosa									<1	4	<1	10								
Tragia stylaris																				
Valeriana capitata							<1	38	<1	33										
Valeriana edulis											<1	10								
Veratrum californicum																				
Verbascum thapsus					<1	11														
Vicia americana					<1	56	2	88	<1	52	<1	30			<1	22	<1	29		
Vicia leucophaea									<1	4	<1	10								
Vicia pulchella					<1	33			<1	7	<1	50	<1	50	<1	44	<1	43		
Viguiera multiflora									<1	4	<1	20	<1	50	<1	33	<1	14	<1	14
Viola canadensis							<1	25	<1	33					<1	11				
Viola nephrophylla																				
Zygadenus elegans							<1	25	<1	7										
Zygadenus virescens																				

Table 6.--Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Pinus ponderosa series.

HTs:	PIPO/MUVI		PIPO/MUVI		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/QUGR		PIPO/QUGR	
	Typic ph.		QUGA ph.		Typic ph.		QUGA ph.		BOGR ph		MUMO ph.		MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees														
Abies concolor - Young regen.			<1	25										
Abies concolor - Advance regen.														
Abies concolor - Mature														
Abies lasiocarpa - Young regen.														
Abies lasiocarpa - Advance regen.														
Abies lasiocarpa - Mature														
Alnus oblongifolia - Young regen.														
Alnus oblongifolia - Advance regen.														
Alnus oblongifolia - Mature														
Juniperus deppeana - Young regen.			<1	25	<1	9			6	75	3	86	7	67
Juniperus deppeana - Advance regen.	<1	33			<1	9			1	50	<1	29	1	56
Juniperus deppeana - Mature											<1	14	<1	33
Juniperus osteosperma - Young regen.							<1	33						
Juniperus osteosperma - Advance regen.							<1	33						
Juniperus osteosperma - Mature														
Juniperus scopulorum - Young regen.			<1	25	<1	9								
Juniperus scopulorum - Advance regen.			<1	25										
Juniperus scopulorum - Mature													<1	11
Picea engelmannii - Young regen.														
Picea engelmannii - Advance regen.														
Picea engelmannii - Mature														
Picea pungens - Young regen.														
Picea pungens - Advance regen.														
Picea pungens - Mature														
Pinus edulis - Young regen.	<1	33	<1	25	<1	9			2	75	2	57	6	78
Pinus edulis - Advance regen.											<1	14	2	44
Pinus edulis - Mature														
Pinus ponderosa - Young regen.	10	100	9	100	11	91	4	67	24	50	3	86	3	44
Pinus ponderosa - Advance regen.	5	100	6	100	10	100	<1	33	1	75	3	86	11	100
Pinus ponderosa - Mature	6	100	5	100	6	100	6	100	7	100	3	86	4	100
Pinus strobiformis - Young regen.	<1	33	<1	25	<1	9					<1	14		
Pinus strobiformis - Advance regen.			<1	25										
Pinus strobiformis - Mature														
Populus angustifolia - Young regen.														
Populus angustifolia - Advance regen.														
Populus angustifolia - Mature														
Populus tremuloides - Young regen.														
Populus tremuloides - Advance regen.					<1	9								
Populus tremuloides - Mature														
Pseudotsuga menziesii - Young regen.			1	50	<1	27					1	43		
Pseudotsuga menziesii - Advance regen.	<1	33			<1	9					<1	14	<1	11
Pseudotsuga menziesii - Mature														
Shrubs														
Acer glabrum														
Acer grandidentatum														
Acer negundo														
Alnus oblongifolia														
Berberis repens			<1	25										
Calliandra humilis											<1	14	<1	22
Ceanothus fendleri	<1	33	<1	50	<1	27							<1	33
Cercocarpus montanus			<1	75							<1	57	<1	44
Chimaphila umbellata														
Cornus stolonifera														
Fraxinus pennsylvanica													<1	11

PIRO/ Rockland (3)		PIPO/FEAR Typic ph. (5)		PIPO/FEAR QUGA ph. (1)		PIPO/FEAR BOGR ph. (7)		PIPO/MUMO (10)		PIPO/QUGA Typic ph. (8)		PIPO/QUGA MULO ph. (4)		PIPO/BOGR PIED ph. (11)		PIPO/BOGR VIAR ph. (1)		PIPO/ARPU CT (2)	
D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Trees																			
5	33	<1	20	1	100	<1	14	6	90	1	50	3	50	5	91	7	100		
4	33					<1	14	2	70	<1	13	3	25	2	82	3	100	3	100
1	33			1	100	<1	14	<1	30	<1	13			<1	18				
						<1	14			<1	13								
								<1	10			3	50						
		<1	20					<1	10										
3	33	<1	20			2	29	1	50	5	75	11	100	2	36			1	50
2	33					<1	14	<1	30			<1	25	<1	18				
												<1	25						
2	67	2	60	2	100	2	71	8	60	3	100	5	75	2	64	22	100	6	50
3	67	7	100	4	100	4	71	5	60	5	88	11	100	2	73	4	100	14	100
2	67	5	100	1	100	4	100	3	90	5	100	6	100	3	91	4	100	2	100
2	33							<1	10	<1	38	<1	25						
1	33									<1	38	<1	25						
<1	33																		
Shrubs																			
										<1	13								
<1	33							<1	30			<1	25	<1	18	<1	100	<1	50
<1	33							1	10	<1	13	<1	25	<1	9	<1	100	<1	50
<1	33							<1	20	<1	25	<1	25					10	50
										<1	13	<1	50						

(continued)

Table 6.--(continued).

HTs:	PIPO/MUVI		PIPO/MUVI		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/QUGR		PIPO/QUGR	
	Typic ph.		QUGA ph.		Typic ph.		QUGA ph.		BOGR ph		MUMO ph.		MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Garrya wrightii													<1	22
Gutierrezia sarothrae									<1	25				
Holodiscus dumosus														
Hymenoxys richardsonii							<1	33	<1	25	<1	14		
Jamesia americana														
Juglans major														
Juniperus communis														
Lonicera albiflora													<1	11
Lonicera arizonica														
Nolina microcarpa													<1	11
Parthenocissus vitacea														
Philadelphus spp.														
Physocarpus monogynus														
Populus tremuloides - shrubs														
Ptelea trifoliata														
Prunus emarginata														
Prunus virginiana														
Quercus chrysolepis														
Quercus emoryi													<1	11
Quercus gambelii	<1	33	5	100	<1	36	2	100			<1	14	<1	44
Quercus grisea	2	33	<1	50							11	100	12	100
Quercus hypoleucoides													<1	11
Quercus rugosa														
Rhamnus betulaefolia														
Rhus glabra														
Rhus trilobata													<1	22
Ribes cereum														
Ribes montigenum														
Ribes pinetorum														
Ribes wolfii														
Robinia neomexicana	<1	33												
Rosa spp.	<1	33			<1	18								
Rubus arizonensis														
Rubus parviflorus														
Rubus strigosus														
Salix bebbiana														
Salix scouleriana														
Salix spp.														
Sambucus spp.						<1	9							
Shepherdia canadensis														
Sorbus dumosa														
Symphoricarpus oreophilus	<1	33												
Toxicodendron rydbergii														
Vaccinium myrtillus														
Vitis arizonica														
Yucca baccata											<1	43	<1	22
Yucca schottii														
Graminoids														
Agropyron arizonicum											<1	14		
Agropyron (smithii?)														
Agrostis alba														
Andropogon spp.			<1	25										
Andropogon cirratus													<1	11
Andropogon gerardi												<1	14	
Andropogon scoparius									<1	25	<1	14		

	PIRO/ Rockland (3) D/C	CON	PIPO/FEAR Typic ph. (5) D/C	CON	PIPO/FEAR QUGA ph. (1) D/C	CON	PIPO/FEAR BOGR ph. (7) D/C	CON	PIPO/MUMO (10) D/C	CON	PIPO/QUGA Typic ph. (8) D/C	CON	PIPO/QUGA MULO ph. (4) D/C	CON	PIPO/BOGR PIED ph. (11) D/C	CON	PIPO/BOGR VIAR ph. (1) D/C	CON	PIPO/ARPU CT (2) D/C	CON
													<1	25					<1	100
	<1	33																		
							<1	43	<1	10					<1	18				
																	<1	100		
																			<1	50
																	<1	100		
																	<1	100		
			<1	80	1	100	<1	43	2	80	34	100	12	100	1	55			1	100
	2	33	<1	40			<1	14	<1	90	<1	13	<1	75	1	55	25	100		
											<1	13	1	50	<1	9			<1	100
																			30	50
																	<1	100		
	<1	33											<1	50					<1	50
							<1	43							<1	9				
											<1	38	<1	25						
																	5	100		
	<1	33							<1	10	<1	13	<1	25						
Graminoids																				
															<1	9				
			<1	40			<1	29	2	50			2	25	1	36				
									1	10					<1	9				
							2	14												
									<1	10										

(continued)

Table 6.--(continued).

HTs:	PIPO/MUVI		PIPO/MUVI		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/QUGR		PIPO/QUGR	
	Typic ph.		QUGA ph.		Typic ph.		QUGA ph.		BOGR ph		MUMO ph.		MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Arlstida spp.														
Aristida arizonica											<1	43	<1	11
Arlstida fendleriana														
Blepharoneuron tricholepis	1	67	<1	100	1	91	3	100	5	100	<1	86	<1	33
Bouteloua curtipendula													<1	33
Bouteloua gracilis			<1	25			<1	33	1	100	2	43	<1	56
Bromus anomalous	<1	67			<1	9								
Bromus carinatus					<1	9								
Bromus clliatus					<1	9					<1	14		
Bromus frondosus					<1	9					<1	14		
Bromus lanatlpes														
Bromus spp.			1	50	<1	73	1	100	<1	25	<1	14	<1	44
Calamagrostls canadensls														
Carex spp.	<1	67	<1	100	<1	73	<1	100	<1	75	<1	86	<1	67
Carex foenea					<1	18								
Carex lanuginosa														
Carex microptera														
Carex occidentalis														
Carex rossii														
Cyperus rusbyi	<1	33									<1	43	<1	22
Cyperus sp.											<1	14		
Elymus glaucus														
Festuca arizonica					4	100	6	100	7	100				
Festuca sororla														
Glycerla elata														
Glycerla strlata														
Koelerla nitlda			1	75	2	91	6	100	6	100	<1	100	<1	56
Luzula parvlflora														
Lycurus phleoides											<1	43		
Melica porteri														
Muhlenbergia longiligula	<1	33									<1	14	4	100
Muhlenbergia montana	2	67	<1	50	4	55					5	100	<1	11
Muhlenbergia monticola														
Muhlenbergia pauciflora													<1	11
Muhlenbergia rigens									<1	25	<1	14	<1	33
Muhlenbergia virescens	19	100	11	100	5	91	8	100	8	100	2	57	1	22
Muhlenbergia wrightii					<1	9			<1	25				
Panicum bulbosum					<1	9								
Plptochaetium fimbriatum													<1	33
Poa compressa						<1	9							
Poa fendlerlana	<1	67	<1	50	3	100	3	100	<1	50	3	71	<1	67
Poa nervosa var tracyl														
Poa pratensis					<1	9								
Sitanion hystrix	<1	33	<1	100	3	91	5	100	2	100	<1	100	<1	78
Sporobolus cryptandrus														
Stipa spp.														
Stipa pringlei					<1	18	<1	33	<1	25				
Trisetum montanum														
Forbs														
Achillea millefolium	<1	33			2	82					<1	29		
Actaea rubra ssp. arguta														
Agrimonia striata														
Allium cernuum					<1	9					<1	14		
Allium kunthii														
Allium rhizomatum														

PIRO/ Rockland		PIPO/FEAR Typic ph.		PIPO/FEAR QUGA ph.		PIPO/FEAR BOGR ph.		PIPO/MUMO		PIPO/QUGA Typic ph.		PIPO/QUGA MULO ph.		PIPO/BOGR PIED ph.		PIPO/BOGR VIAR ph.		PIPO/ARPU CT	
(3)		(5)		(1)		(7)		(10)		(8)		(4)		(11)		(1)		(2)	
D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
														<1	9	<1	100		
		<1	80			<1	57	<1	60			<1	25	2	82	3	100		
														<1	9				
<1	33	3	80	4	100	3	71	2	100	<1	38	<1	25	<1	64				
<1	33							<1	10			<1	25	<1	9				
1	33	<1	20			6	100	2	100	<1	25	<1	50	18	100	25	100		
<1	33													<1	18				
								<1	10							<1	100		
								<1	10	<1	13								
								<1	10					<1	18				
		<1	40					<1	30	<1	50	<1	25	<1	27	<1	100		
<1	33	<1	40			1	71	<1	70	<1	63	1	100	<1	73			<1	50
<1	33	<1	20					<1	20					<1	9				
																<1	100		
<1	33	3	100	2	100	7	100			<1	13								
<1	33	<1	100	<1	100	3	57	<1	90	<1	63	<1	50	1	55				
						<1	29	<1	20					<1	55	<1	100		
<1	33							<1	10	<1	13	5	100	<1	9			<1	50
4	67	16	100	8	100	7	86	10	100	<1	50			<1	36				
<1	33	<1	40			<1	14	<1	40					<1	18				
1	33							<1	10	<1	38	<1	25	<1	18			<1	50
						<1	14	<1	10										
								<1	20					<1	9	<1	100		
<1	33	<1	40	4	100	1	86	2	60	3	100	<1	100	<1	64			<1	50
														<1	9				
		1	80	3	100	3	100	3	100	2	88	<1	50	2	100	<1	100	<1	50
														<1	9				
																		<1	50
		13	20																
Forbs																			
<1	33	<1	40	3	100	<1	29	<1	40	<1	63	<1	25	<1	18				
														<1	9				
		<1	40																
						<1	14	1	30										

(continued)

Table 6.--(continued).

HTs:	PIPO/MUVI		PIPO/MUVI		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/QUGR		PIPO/QUGR	
	Typic ph.		QUGA ph.		Typic ph.		QUGA ph.		BOGR ph		MUMO ph.		MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Antennaria marginata	<1	33	<1	25	<1	18								
Antennaria parvifolia			<1	25	<1	45	<1	67			<1	14		
Antennaria spp.														
Aquilegia chrysantha														
Aquilegia elegantula														
Aquilegia triternata														
Arabis spp.	<1	33			<1	18					<1	14	<1	11
Arenaria lanuginosa	<1	33									<1	14		
Arenaria spp.														
Artemisia carruthii	1	67	<1	50	<1	18	<1	33	<1	25	<1	29	<1	33
Artemisia dracunculoides											<1	14		
Artemisia franserioides														
Artemisia frigida														
Artemisia ludoviciana	<1	33	<1	50	<1	55	<1	67	<1	50	<1	57	<1	33
Asclepias spp.											<1	29		
Aster falcatus									<1	25				
Astragalus egglestonii													<1	11
Astragalus gilensis			<1	50							<1	43		
Astragalus humistratus														
Astragalus spp.			<1	75	<1	36	<1	33	<1	50			<1	11
Bahia dissecta	<1	33	<1	50	<1	9			<1	25	<1	43	<1	22
Brickellia brachyphylla														
Brickellia fendleri														
Brickellia grandiflora					<1	9								
Brickellia spp.	<1	33									<1	14	<1	22
Calypso bulbosa														
Campanula rotundifolia														
Cardamine cordifolia														
Castilleja spp.					<1	18					<1	14		
Chaptalia alsophila					<1	18								
Chamerion angustifollum														
Cicuta douglasii														
Circaea alpina														
Cirsium spp.	<1	33	<1	75	<1	64	<1	67	<1	50	<1	29	<1	33
Cirsium parryi														
Cirsium wheeleri											<1	14		
Clematis ligusticifolia														
Clematis pseudoalpina														
Cologania longifolia	<1	67			<1	18			<1	25	<1	14	<1	33
Commelina dianthifolia	<1	33			<1	9					<1	43		
Corallorhiza spp.														
Corallorhiza maculata														
Cryptantha jamesii							<1	33	<1	25				
Cucurbita foetidissima														
Cystopteris fragilis														
Delphinium tenuisectum														
Desmanthus cooleyi													<1	11
Disporum trachycarpum														
Draba helleriana					<1	9					<1	14		
Dugaldia hoopesii														
Equisetum arvense														
Equisetum laevigatum														
Erigeron concinnus					<1	9								
Erigeron delphinifolius	<1	33	<1	75	<1	27	<1	67	<1	50	<1	14	<1	22
Erigeron divergens														
Erigeron eximius														

PIRO/ Rockland		PIPO/FEAR Typic ph.		PIPO/FEAR QUGA ph.		PIPO/FEAR BOGR ph.		PIPO/MUMO		PIPO/QUGA Typic ph.		PIPO/QUGA MULO ph.		PIPO/BOGR PIED ph.		PIPO/BOGR VIAR ph.		PIPO/ARPU CT	
(3)		(5)		(1)		(7)		(10)		(8)		(4)		(11)		(1)		(2)	
D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
<1	33							<1	10										
		<1	40					<1	20	<1	25	<1	25						
						<1	29			<1	13	<1	50	<1	18	<1	100		
										<1	13								
1	33					<1	14	<1	30	1	88	<1	75	<1	27			<1	100
						<1	29							<1	9				
<1	67	<1	80			<1	29	<1	30	<1	13	<1	50	<1	45	8	100		
		<1	20			<1	14	<1	20										
						<1	14	<1	10	<1	13			<1	9				
		<1	60	<1	100	<1	29	<1	20	<1	25	<1	50	<1	36				
								<1	20	<1	13			<1	18				
		<1	40			<1	43	<1	20	<1	13			<1	27				
		<1	20	<1	100			<1	30	<1	25			<1	64				
<1	67							<1	10	<1	50	<1	25					<1	50
<1	33																		
<1	33	<1	40			<1	86	<1	20	<1	25	<1	25	<1	45				
		<1	20			<1	14	<1	10										
<1	33	<1	20					<1	30	<1	13			<1	18				
<1	33							<1	30					<1	9				
		<1	20			<1	43	<1	10					<1	18				
														<1	9				
										<1	13								
														<1	18				
<1	33	<1	20							<1	13								
<1	33							<1	10	<1	13	<1	25						
		<1	20	1	100			<1	20					<1	18				

(continued)

Table 6.--(continued).

HTs:	PIPO/MUVI Typic ph.		PIPO/MUVI QUGA ph.		PIPO/MUVI -FEAR Typic ph.		PIPO/MUVI -FEAR QUGA ph.		PIPO/MUVI -FEAR BOGR ph		PIPO/QUGR MUMO ph.		PIPO/QUGR MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Erigeron flageilaris	<1	100	<1	25	<1	45	<1	67	<1	50	<1	43	<1	33
Erigeron formosissimus			<1	25	<1	9					<1	14		
Erigeron platyphylius	<1	33	<1	50	<1	36			<1	25	<1	14	<1	11
Eriogonum aiatum			<1	25	<1	18	<1	67	<1	75	<1	43	<1	44
Eriogonum jamesil	<1	33							<1	50	<1	43		
Erysimum capitatum	<1	33									<1	14		
Fragaria americana														
Fragaria ovails	<1	33			<1	9								
Gailum spp.					<1	9	<1	33			<1	14		
Galium fendleri														
Gaiium mexicanum														
Gaura hexandra			<1	25							<1	14	<1	11
Gentianeila amareila s. acuta					<1	9								
Geranium caespitosum	<1	67	<1	75	<1	82	<1	33	<1	50	<1	57	<1	56
Geranium richarsonii														
Geranium spp.	<1	33					<1	33						
Geum aleppicum ssp. strictum														
Gnaphaiium macounii														
Goodyera obionglfoiia														
Goodyera repens														
Halenia recurva					<1	18								
Hapiopappus parryi					<1	9								
Hedeoma obiongifolium	<1	33	<1	25							<1	29	<1	44
Hedyotis pygmea			<1	25	<1	36					<1	43	<1	33
Heiiantheila parryi			<1	25							<1	14		
Heterotheca fuicrata			<1	25	<1	18	<1	67	<1	25				
Hieracium fendleri			<1	25	<1	36	<1	33			<1	14	<1	33
Hydrophyiium fendieri														
Hymenopappus filifoiius														
Hymenopappus mexicanus			<1	50	<1	9	<1	33					<1	11
Hypericum formosum														
ipomopsis aggregata	<1	33	<1	100	<1	36	<1	67			<1	43	<1	22
iris missouriensis	<1	33			<1	18			<1	25				
Kuhnia chlorolepis									<1	25	<1	29	<1	33
Lactuca graminifoiia														
Lathyrus arizonicus	<1	33			<1	18			<1	25	<1	14		
Lathyrus graminifoiius	<1	33	<1	25	<1	27	<1	33			<1	14		
Leucelene ericoides														
Ligusticum porteri														
Llnum lewlsii	<1	33			<1	9					<1	14		
Lithospermum multiflorum	<1	33	<1	75	<1	45	<1	100	<1	25	<1	29	<1	44
Lobelia anatina					<1	9								
Lotus wrightii	<1	67	<1	50	<1	27	<1	33	<1	50	<1	43	<1	44
Lupinus neomexicanus					1	9							<1	11
Lupinus spp.	<1	33												
Maiaxls ehrenbergii														
Maiaxis soulei	<1	33												
Mertensia franciscana														
Monarda menthaefoiia														
Opuntia spp. (prickly pears)											<1	14	<1	33
Osmorhiza depauperata														
Oxaiis metcaifei					<1	9								
Oxybaphus linearis											<1	29		
Oxypoiis fendieri														
Oxytropis lambertii			<1	25	<1	9	<1	33	<1	50	<1	14	<1	11
Pedlcuiaris angustifolia														

PIRO/ Rockland		PIPO/FEAR Typic ph.		PIPO/FEAR QUGA ph.		PIPO/FEAR BOGR ph.		PIPO/MUMO		PIPO/QUGA Typic ph.		PIPO/QUGA MULO ph.		PIPO/BOGR PIED ph.		PIPO/BOGR VIAR ph.		PIPO/ARPU CT	
(3)		(5)		(1)		(7)		(10)		(8)		(4)		(11)		(1)		(2)	
D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
1	33	<1	40	4	100	<1	57	<1	40	<1	38	<1	75	2	82			<1	50
		<1	60					<1	20										
<1	67	<1	20					<1	10	<1	25	<1	25						
<1	67	<1	20			<1	43	<1	40	<1	13	<1	25	<1	64				
<1	33																		
						<1	14			<1	25			<1	9				
		<1	20																
								<1	10										
<1	33											<1	25					<1	50
										<1	13								
		<1	40	<1	100									<1	9				
<1	100	<1	40	1	100	<1	43	<1	60	<1	88	<1	25	1	91	<1	100	<1	50
<1	33																		
<1	33	<1	60	<1	100	<1	29	<1	60					<1	64				
		<1	20																
<1	33													<1	18				
<1	67	<1	20	<1	100	<1	57	<1	30	<1	13	<1	25	<1	9				
												<1	25						
<1	67	<1	40											<1	18				
<1	33	<1	40			<1	29	<1	20	<1	63	<1	25	<1	27				
<1	33																		
																<1	100		
										<1	13								
<1	33	<1	20	<1	100	<1	29	<1	30	<1	50	<1	25						
		<1	20			<1	29	<1	10					<1	9				
<1	33	<1	20			<1	14	<1	10					<1	9				
<1	67	<1	40			<1	14	<1	20	<1	88	<1	50						
								<1	10										
<1	33	<1	20			<1	14	<1	70	<1	50	<1	100	<1	91	<1	100		
		<1	20																
										<1	13					<1	100		
<1	33							<1	20			<1	25	<1	18				
<1	33					<1	14												
<1	33							<1	10					<1	18				
		<1	40	<1	100	<1	43							<1	9				

(continued)

Table 6.--(continued).

HTs:	PIPO/MUVI		PIPO/MUVI		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/QUGR		PIPO/QUGR	
	Typic ph.		QUGA ph.		Typic ph.		QUGA ph.		BOGR ph		MUMO ph.		MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Pedicularis grayii														
Pedicularis racemosa														
Penstemon barbatus	<1	33			<1	18					<1	29	<1	22
Penstemon linarioides													<1	11
Penstemom oliganthus														
Penstemon pinifolius											<1	14		
Penstemon whippleanus														
Petalostemom candidum													<1	11
Polygonum sawatchensis					<1	9								
Potentilla crinita					<1	27			<1	50				
Potentilla gracilis v pulcher														
Potentilla hippiana	<1	33			<1	27								
Potentilla spp.					<1	18	<1	67			<1	14		
Potentilla thurberi														
Prunella vulgaris									<1	25				
Pseudocymopteris montanus	<1	33	<1	75	<1	73	<1	33			<1	14	<1	11
Pseudostellaria jamesiana														
Psoralea tenuiflora														
Pteridium aquilinum					<1	9								
Pterospora andromeda														
Pyrola chlorantha														
Pyrola picta														
Ramischia secunda														
Ratibida columnaris														
Rudbeckia laciniata														
Rumex acetosella														
Rumex crispus														
Rumex occidentalis														
Senecio actinella	<1	33			<1	27								
Senecio bigelovii														
Senecio cardamine														
Senecio cynthioides											<1	14		
Senecio eremophilus														
Senecio neomexicanus	<1	100	<1	100	<1	91	<1	33	<1	25	<1	57	<1	22
Senecio quaerens														
Senecio wootoni	<1	33	<1	50	<1	27								
Sidalcea neomexicana														
Silene laciniata					<1	9								
Silene scouleri			<1	25							<1	29		
Sisymbrium linearifolium	<1	67	<1	25	<1	9					<1	71	<1	44
Smilacina racemosa														
Smilacina stellata														
Solidago spathulata var neomex														
Solidago spp.	<1	33	<1	25	<1	9					<1	29	<1	22
Solidago wrightii			<1	25										
Sphaeralcea coccinea	<1	33							<1	25	<1	29	<1	11
Swertia radiata														
Taraxacum spp.					<1	18								
Thalictrum fendleri	<1	33	<1	25	<1	36	<1	67					<1	11
Thermopsis pinetorum														
Townsendia formosa					<1	18								
Tragia stylaris					<1	9					<1	14	<1	44
Valeriana capitata														
Valeriana edulis														
Veratrum californicum														
Verbascum thapsus														

PIRO/ Rockland		PIPO/FEAR Typic ph.		PIPO/FEAR QUGA ph.		PIPO/FEAR BOGR ph.		PIPO/MUMO		PIPO/QUGA Typic ph.		PIPO/QUGA MULO ph.		PIPO/BOGR PIED ph.		PIPO/BOGR VIAR ph.		PIPO/ARPU CT	
(3) D/C	CON	(5) D/C	CON	(1) D/C	CON	(7) D/C	CON	(10) D/C	CON	(8) D/C	CON	(4) D/C	CON	(11) D/C	CON	(1) D/C	CON	(2) D/C	CON
<1	33					<1	14			<1	25	<1	25	<1	9	<1	100		
														<1	9				
<1	33					<1	14	<1	10			<1	50	<1	27				
						<1	14							<1	18				
		<1	20			<1	14	<1	10					<1	9				
<1	33	<1	40	<1	100			<1	10										
		<1	20			<1	14									<1	100		
		<1	80			<1	57	<1	60	<1	38	<1	25	<1	36				
										<1	13								
														<1	9				
		<1	40					<1	10					<1	36				
<1	100	<1	60			<1	14	<1	60	<1	63	<1	75	<1	45	<1	100	<1	50
<1	33																		
										<1	13								
								<1	10										
						<1	14	<1	20	<1	38	<1	25	<1	36				
								<1	20	<1	25	<1	75	<1	9				
				<1	100	<1	14	<1	20					<1	55	<1	100		
														<1	18				
								<1	10										
										<1	63			<1	9				
										<1	13								
								<1	30					<1	9				
<1	33									<1	13			<1	9				
<1	33																		
						<1	29							<1	9				

(continued)

Table 6.--(continued).

HTs:	PIPO/MUVI		PIPO/MUVI		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/MUVI -FEAR		PIPO/QUGR		PIPO/QUGR	
	Typic ph.		QUGA ph.		Typic ph.		QUGA ph.		BOGR ph		MUMO ph.		MULO ph.	
No. plots:	(3)		(4)		(11)		(3)		(4)		(7)		(9)	
	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
Vicia americana	<1	33			<1	45								
Vicia leucophaea	<1	33	<1	25										
Vicia pulchella	<1	67	<1	75	<1	27	<1	33			<1	14		
Viguiera multiflora			<1	25	<1	27			<1	25	<1	43	<1	33
Viola canadensis														
Viola nephrophylla														
Zygadenus elegans														
Zygadenus virescens														

PIRO/ Rockland		PIPO/FEAR Typic ph.		PIPO/FEAR QUGA ph.		PIPO/FEAR BOGR ph.		PIPO/MUMO		PIPO/QUGA Typic ph.		PIPO/QUGA MULO ph.		PIPO/BOGR PIED ph.		PIPO/BOGR VIAR ph.		PIPO/ARPU CT	
(3)		(5)		(1)		(7)		(10)		(8)		(4)		(11)		(1)		(2)	
D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON	D/C	CON
		<1	20					<1	10	<1	25			<1	9				
		<1	20					<1	10			<1	25	<1	18				
<1	67					<1	14	<1	10	<1	25			<1	9				
<1	33	<1	20					<1	20	<1	25	<1	25	<1	27				

Table 7.--Tree density (D) or shrub-herb cover (C) and constancy (CON) for Apache-Gila-Cibola(Madg.): Populus angustifolia series.

HTs: POAN No. plots: (9)	D/C	CON
Trees		
Abies concolor - Young regen.	8	44
Ables concolor - Advance regen.	4	44
Ables concolor - Mature	<1	22
Ables laslocarpa - Young regen.		
Ables laslocarpa - Advance regen.		
Ables laslocarpa - Mature		
Alnus oblongifolia - Young regen.	1	11
Alnus oblongifolia - Advance regen.	1	33
Alnus oblongifolia - Mature	<1	44
Juniperus deppeana - Young regen.	<1	22
Juniperus deppeana - Advance regen.	<1	22
Junlperus deppeana - Mature		
Junlperus osteosperma - Young regen.		
Junlperus osteosperma - Advance regen.		
Junlperus osteosperma - Mature		
Junlperus scopulorum - Young regen.	<1	11
Junlperus scopulorum - Advance regen.		
Juniperus scopulorum- Mature		
Picea engelmannii - Young regen.		
Picea engelmannii - Advance regen.		
Picea engelmannii - Mature		
Picea pungens - Young regen.		
Picea pungens - Advance regen.		
Picea pungens - Mature		
Plnus edulis - Young regen.	<1	11
Pinus edulis - Advance regen.		
Plnus edulis - Mature		
Plnus ponderosa - Young regen.	<1	11
Plnus ponderosa - Advance regen.	1	44
Pinus ponderosa - Mature	1	44
Pinus strobiformis - Young regen.	<1	22
Pinus strobiformis - Advance regen.		
Pinus strobiformis - Mature	<1	22
Populus angustifolia - Young regen.	1	22
Populus angustifolia - Advance regen.	2	33
Populus angustifolia - Mature	<1	33
Populus tremuloides - Young regen.		
Populus tremuloides - Advance regen.		
Populus tremuloides - Mature		
Pseudotsuga menziesii - Young regen.	3	67
Pseudotsuga menziesii - Advance regen.	4	56
Pseudotsuga menziesii - Mature	<1	44
Shrubs		
Acer glabrum	<1	22
Acer grandidentatum	2	11
Acer negundo	3	33
Alnus oblongifolia	16	44
Berberis repens		
Calliandra humilis		
Ceanothus fendleri		
Cercocarpus montanus		
Chimaphila umbellata	<1	11
Cornus stolonifera	<1	11
Fraxinus pennsylvanica	<1	22
Garrya wrightii		
Gutierrezia sarothrae		
Holodiscus dumosus	<1	11
Hymenoxys richardsonii		
Jamesia americana	<1	11
Juglans major	3	44
Juniperus communis		
Lonicera albiflora		
Lonicera arizonica	<1	11
Nolina microcarpa		
Parthenocissus vitacea	2	33
Philadelphus spp.		
Physocarpus monogynus	<1	11
Populus tremuloides - shrubs		
Ptelea trifoliata	<1	22
Prunus emarginata		
Prunus virginiana	<1	11
Quercus chrysolepis		
Quercus emoryi		
Quercus gambelii	6	67
Quercus grisea		
Quercus hypoleucoides	<1	11
Quercus rugosa	2	22
Rhamnus betulaefolia	1	44
Rhus glabra	2	11
Rhus trilobata	<1	11
Ribes cereum		
Ribes montigenum		
Ribes pinetorum		
Ribes wolfii		
Robinia neomexicana	<1	11
Rosa spp.	<1	11
Rubus arizonensis	<1	11
Rubus parviflorus		
Rubus strigosus	<1	11
Salix bebbiana		
Salix scouleriana		
Salix spp.	3	44

(continued)

Table 7.--(continued).

HTs: POAN No. plots: (9)	D/C	CON
Sambucus spp.		
Shepherdia canadensis		
Sorbus dumosa		
Symphoricarpus oreophilus	<1	22
Toxicodendron rydbergii	<1	44
Vaccinium myrtillus		
Vitis arizonica	1	44
Yucca baccata		
Yucca schottii		
Graminoids		
Agropyron arizonicum		
Agropyron (smithii?)	1	11
Agrostis alba	<1	11
Andropogon spp.		
Andropogon cirratus		
Andropogon gerardi		
Andropogon scoparius		
Aristida spp.		
Aristida arizonica	<1	11
Aristida fendleriana		
Blepharoneuron tricholepis	<1	22
Bouteloua curtipendula		
Bouteloua gracilis	<1	11
Bromus anomalous		
Bromus carinatus		
Bromus ciliatus	<1	33
Bromus frondosus		
Bromus lanatipes	<1	33
Bromus spp.	2	33
Calamagrostis canadensis		
Carex spp.	<1	67
Carex foenea		
Carex lanuginosa		
Carex microptera		
Carex occidentalis	<1	33
Carex rossii	<1	11
Cyperus rusbyi		
Cyperus sp.		
Elymus glaucus		
Festuca arizonica		
Festuca sororia		
Glyceria elata	<1	11
Glyceria striata	<1	11
Koeleria nitida		
Luzula parviflora		
Lycurus phleoides		
Melica porteri	<1	11
Muhlenbergia longiligula		
Muhlenbergia montana	<1	11
Muhlenbergia monticola		
Muhlenbergia pauciflora		
Muhlenbergia rigens	<1	11
Muhlenbergia virescens	<1	22
Muhlenbergia wrightii	<1	11
Panicum bulbosum		
Piptochaetium fimbriatum		
Poa compressa	<1	11
Poa fendleriana	2	67
Poa nervosa var tracyi		
Poa pratensis	8	56
Sitanion hystrix	<1	33
Sporobolus cryptandrus		
Stipa spp.		
Stipa pringlei	<1	11
Trisetum montanum		
Forbs		
Achillea millefolium	<1	33
Actaea rubra ssp. arguta	<1	11
Agrimonia striata	1	33
Allium cernuum		
Allium kunthii		
Allium rhizomatum		
Antennaria marginata		
Antennaria parvifolia		
Antennaria spp.		
Aquilegia chrysantha	<1	22
Aquilegia elegantula		
Aquilegia triternata		
Arabis spp.	<1	11
Arenaria lanuginosa		
Arenaria spp.		
Artemisia carruthii	<1	33
Artemisia dracunculoides	<1	11
Artemisia franserioides		
Artemisia frigida		
Artemisia ludoviciana	<1	33
Asclepias spp.	<1	11
Aster falcatus		
Astragalus egglestonii		
Astragalus gilensis		
Astragalus humistratus		
Astragalus spp.		
Bahia dissecta	<1	11

(continued)

Table 7.--(continued).

HTs: ..... POAN No. plots: ..... (9)	D/C	CON
Brickellia brachyphylla		
Brickellia fendleri		
Brickellia grandiflora		
Brickellia spp.	<1	56
Calypso bulbosa		
Campanula rotundifolia	<1	11
Cardamine cordifolia	<1	11
Castilleja spp.		
Chaptalia alsophila		
Chamerion angustifolium		
Cicuta douglasii	<1	11
Circaea alpina	1	22
Cirsium spp.		
Cirsium parryi		
Cirsium wheeleri		
Clematis ligusticifolia	<1	33
Clematis pseudoalpina		
Cologania longifolia		
Commelina dianthifolia		
Corallorhiza spp.		
Corallorhiza maculata	<1	11
Cryptantha jamesii		
Cucurbita foetidissima		
Cystopteris fragilis	<1	22
Delphinium tenuisectum		
Desmanthus cooleyi		
Disporum trachycarpum		
Draba helleriana	<1	11
Dugaldia hoopesii		
Equisetum arvense	<1	11
Equisetum laevigatum	<1	11
Erigeron concinnus		
Erigeron delphinifolius		
Erigeron divergens		
Erigeron eximius		
Erigeron flagellaris	<1	11
Erigeron formosissimus		
Erigeron platyphyllus		
Eriogonum alatum		
Eriogonum jamesii		
Erysimum capitatum		
Fragaria americana	<1	11
Fragaria ovalis	<1	11
Galium spp.		
Galium fendleri		
Galium mexicanum	<1	11
Gaura hexandra	<1	11

HTs: ..... POAN No. plots: ..... (9)	D/C	CON
Gentianella amarella s. acuta		
Geranium caespitosum	<1	33
Geranium richarsonii	<1	22
Geranium spp.	<1	22
Geum aleppicum ssp. strictum		
Gnaphalium macounii		
Goodyera oblongifolia		
Goodyera repens		
Halenia recurva		
Haplopappus parryi		
Hedeoma oblongifolium		
Hedyotis pygmea		
Helianthella parryi		
Heterotheca fulcrata	<1	11
Hieracium fendleri		
Hydrophyllum fendleri		
Hymenopappus filifolius		
Hymenopappus mexicanus	<1	11
Hypericum formosum	<1	11
Ipomopsis aggregata	<1	22
Iris missouriensis		
Kuhnia chlorolepis		
Lactuca graminifolia	<1	22
Lathyrus arizonicus	<1	56
Lathyrus graminifolius	<1	11
Leucelene ericoides		
Ligusticum porteri	<1	22
Linum lewisii		
Lithospermum multiflorum	<1	11
Lobelia anatina		
Lotus wrightii		
Lupinus neomexicanus	<1	11
Lupinus spp.		
Malaxis ehrenbergii		
Malaxis soulei		
Mertensia franciscana	<1	11
Monarda menthaefolia	4	67
Opuntia spp. (prickly pears)		
Osmorhiza depauperata	<1	11
Oxalis metcalfei	<1	11
Oxybaphus linearis		
Oxypolis fendleri	<1	11
Oxytropis lambertii		
Pedicularis angustifolia		
Pedicularis grayii		
Pedicularis racemosa		

(continued)

Table 7.--(continued).

HTs: ..... POAN No. plots: ..... (9)	D/C	CON	HTs: ..... POAN No. plots: ..... (9)	D/C	CON
Penstemon barbatus	<1	22	Senecio neomexicanus	<1	11
Penstemon linarioides			Senecio quaerens	2	56
Penstemom olliganthus			Senecio wootoni	<1	22
Penstemon plnifollus			Sidalcea neomexicana		
Penstemon whlppleanus			Sllene lacinlata		
Petalostemom candidum			Sllene scouleri		
Polygonum sawatchensis			Slsymbrlum llnearifollum		
Potentilla crinita			Smilacina racemosa	<1	33
Potentilla gracilis v pulcher			Smilacina stellata	<1	11
Potentilla hippiana			Solidago spathulata var neomex		
Potentilla spp.			Solidago spp.	<1	22
Potentilla thurberi			Solidago wrightii		
Prunella vulgaris	<1	22	Sphaeralcea coccinea		
Pseudocymopterls montanus	<1	11	Swertia radiata	<1	11
Pseudostellaria jamesiana			Taraxacum spp.	2	44
Psoralea tenuiflora			Thalictrum fendleri	1	67
Pteridlum aquilinum			Thermopsis pinetorum		
Pterospora andromeda			Townsendia formosa		
Pyrola chlorantha	<1	11	Tragia stylaris		
Pyrola picta	<1	11	Valeriana capitata	<1	22
Ramischia secunda			Valeriana edulis		
Ratibida columnaris			Veratrum californicum	<1	11
Rudbeckia lacinlata	<1	11	Verbascum thapsus	<1	33
Rumex acetosella	<1	22	Vicia americana	<1	33
Rumex crispus			Vicla leucophaea		
Rumex occidentalis			Vicla pulchella	<1	22
Senecio actinella			Viguiera multiflora	<1	11
Senecio bigelovii			Viola canadensis	<1	56
Senecio cardamine			Vlola nephrophylla	<1	11
Senecio cynthioides			Zygadenus elegans		
Senecio eremophilus			Zygadenus virescens		

Appendix E. Plants indicative of riparian sites. (The list includes some species that are associated with streamside zones according to the Riparian Area Handbook[15], but not others that sometimes may be found in nonriparian situations as well.)

Trees

Acer grandidentatum
Acer negundo
Alnus oblongifolia
Juglans major

Shrubs and Vines

Cornus stolonifera
Potentilla fruticosa
Salix bebbiana
Salix subcoerulea
Vitis arizonica

Graminoids

Glyceria spp.
Juncus spp.
Scirpus microcarpus

Forbs

Aconitum columbianum
Cicuta douglasii
Equisetum spp.
Prunella vulgaris
Ranunculus hydrocharioides
Rudbeckia laciniata
Veratrum californicum

[15]*Riparian Area Handbook. Forest Service Handbook 2509.23, U.S. Forest Service, Southwestern Region, Albuquerque, New Mexico, February 1985.*

Rocky Mountains

Southwest

Great Plains

U.S. Department of Agriculture
Forest Service

Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

RESEARCH FOCUS

Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

RESEARCH LOCATIONS

Research Work Units of the Rocky Mountain Station are operated in cooperation with universities in the following cities:

Albuquerque, New Mexico
Flagstaff, Arizona
Fort Collins, Colorado*
Laramie, Wyoming
Lincoln, Nebraska
Rapid City, South Dakota
Tempe, Arizona

*Station Headquarters: 240 W. Prospect St., Fort Collins, CO 80526